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48-PAGE SPECIAL:
HOME IMPROVEMENT

Popular Mechanics

**ARMY'S NEW
A TOUGH
TANK-BU**

1,317,000-MILE REPORT

**Chevy Camaro Owners
Bought For Styling,
Praise Handling, Too**

**PLANS: Build PM's
Compact In-A-Wall
Workshop**

**22 Window
Treatments That
Save Energy**

**How To Fix
Leaks In Any
Home Faucet**

**Giant Luxury
Dirigibles
Fly Again**

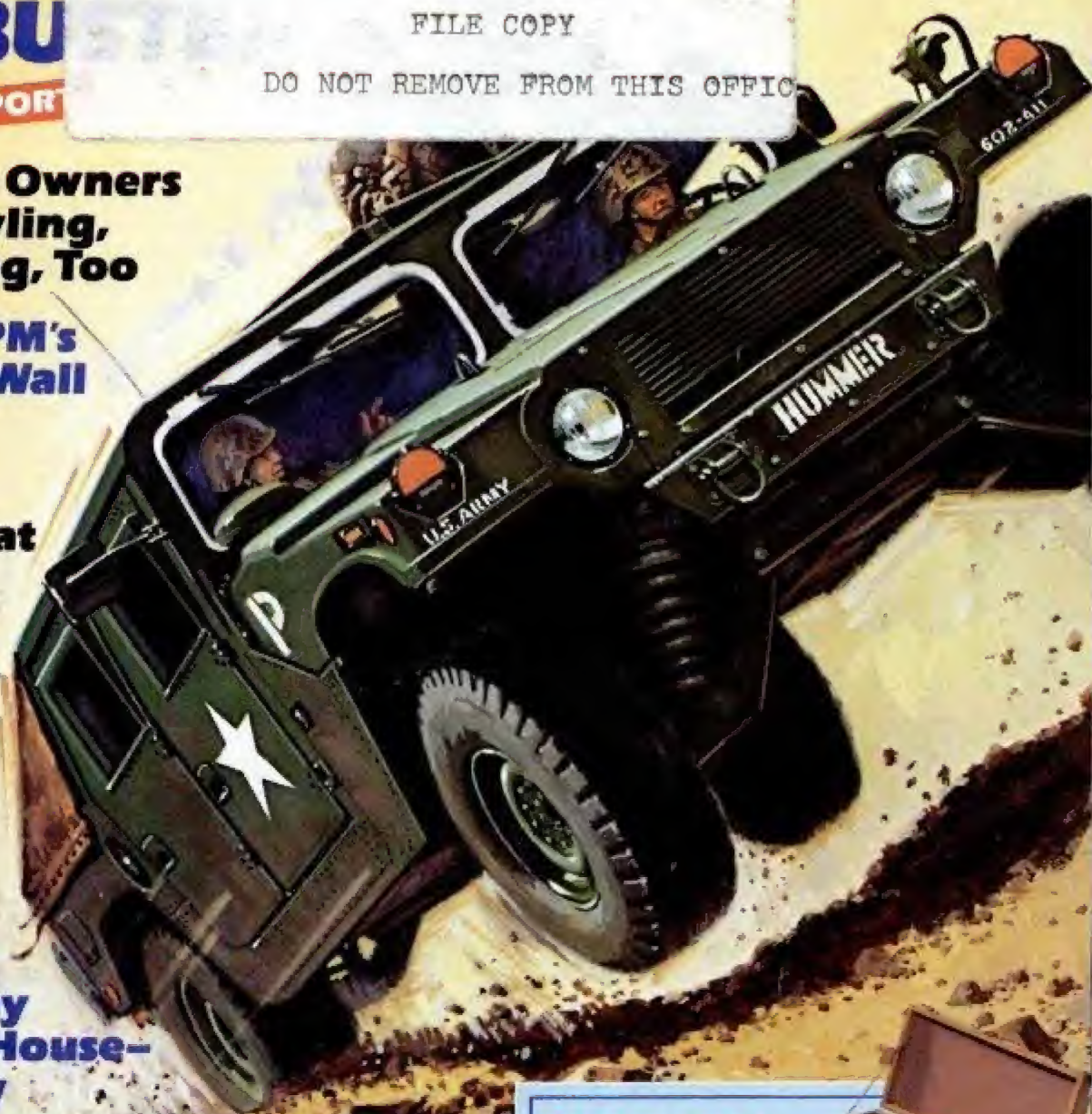
**Step-By-Step:
The Fastest Way
To Paint Your House—
Brush Or Spray**

**PM Drives Ford's New
Turbo T-Bird**

APRIL 1983

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**COMPLETE
PLANS
INSIDE:
Build Our
Classic
Craftsman's
Toolbox**



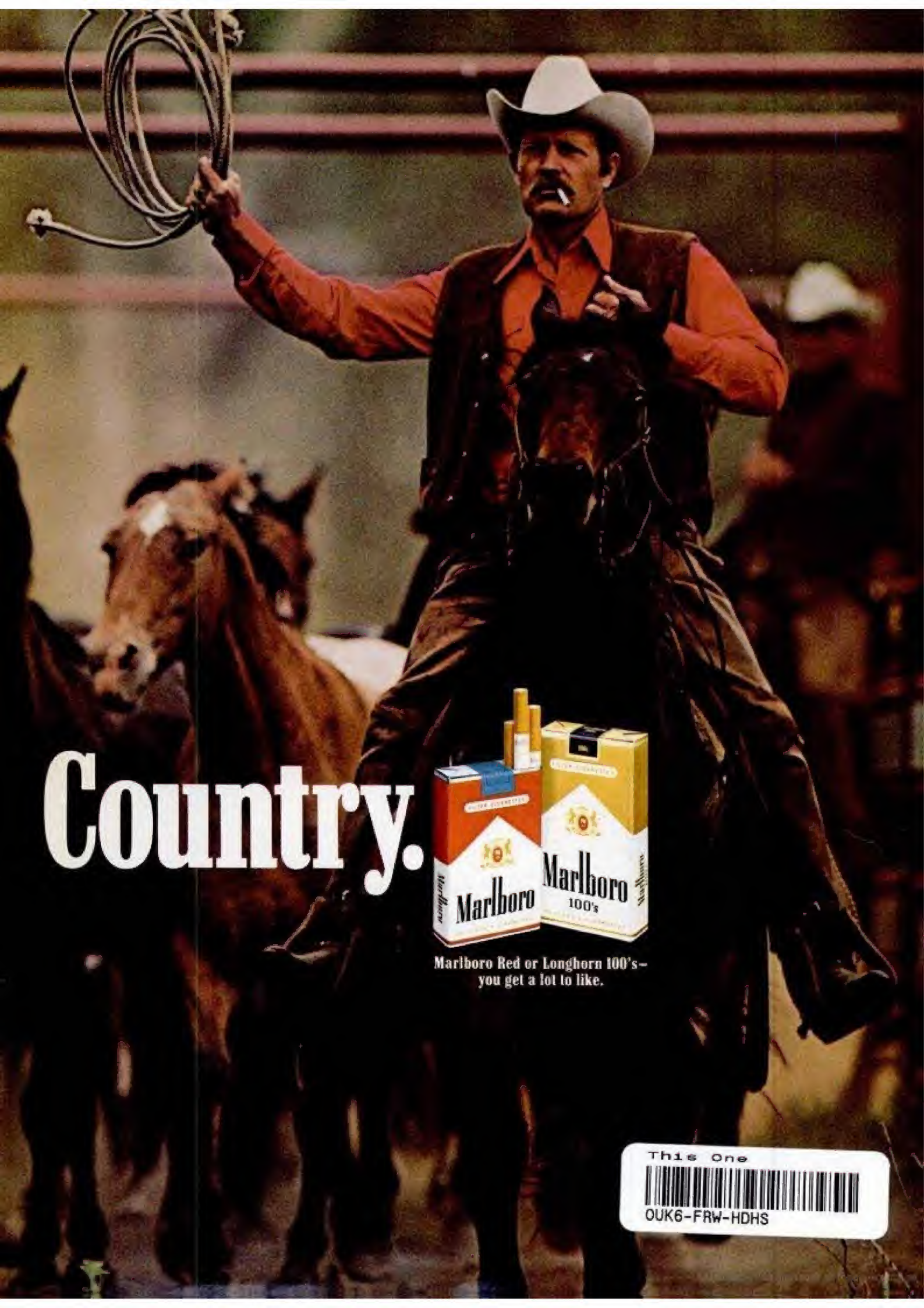
A photograph of several horses in a stable. In the foreground, two dark brown horses are prominent, one on the left and one on the right, both looking towards the camera. Behind them, other horses of various colors (white, brown, black) are visible. In the background, a person wearing a white cowboy hat and a dark shirt is standing, looking towards the horses. The stable has wooden walls and a metal railing.

Come to Marlboro

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OUTBOARDS





On the cover

After more than 40 years, the historic Army jeep is being replaced—but may not be mourned for long. Its successor, a tough new breed of missile-toting tank-buster, promises to be even more awesome. Read how the Army is choosing the new super jeep from three competing designs. Story begins on page 89.

—PM painting by Ed Valigursky

Popular Mechanics®

APRIL 1983

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AS A SERVICE TO READERS, Popular Mechanics publishes newsworthy products, techniques and scientific and technological developments. Due to possible variance in the quality and condition of materials and workmanship, Popular Mechanics cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from plans published in this magazine.

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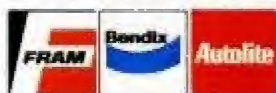
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EDITOR'S NOTES

John A. Lattin

This is our kind of guy. A young acquaintance, recently married in Des Moines, was fêted at a surprise shower. The table centerpiece for the occasion was a toolbox filled with flowers. Most unusual, though, was the fact that his name had been registered at a hardware store—just as a bride's name is listed at a department store—for wedding gifts. The groom's gifts were hammers, saws, drills and such to set up a shop in his first new home. And he carried all his new tools home in the centerpiece. We haven't heard yet how the local society columns reported it.

Should you paint right over your windows when you paint your house? We wouldn't have, at least until we learned from a 40-year veteran that it's really quicker to spray paint and scrape than it is to mask all the windows. Complete instructions for painting your home—by spray gun or by brush—are just one part of our idea-packed *Home Ideas Guide* (page 113).

The writer of the spray painting article, staff member Michael Chotiner, appears on this page for the first time since he joined us last July. After graduating from Rutgers University with a degree in comparative literature, he started working for a home-improvement contractor, he says, to support his habit of writing poems. "I found myself in a trade that captured my imagination," he adds.

From home remodeling to making elegant built-in furniture for Fifth Avenue apartments, he went on to run a cabinet shop and then into his own contracting business. Michael has also written a vocational training course, as well as three books on building crafts.

Another byline in the *Home Ideas Guide* is that of Rosario Capotosto. He's far from being a first-timer in PM's pages, as regular readers know.

Rosario built and photographed the In-A-Wall Workshop (page 126) in the craftsmanlike way that he's done dozens of similar projects for us in the past 10 years. With 30 years of preparing how-to articles and books plus 29 years of teaching commercial photography in New York schools, Rosario has an unbeatable wealth of skills.

But he doesn't let his expertise blind him to one PM basic: "My first consideration always," he says, "is to devise construction methods for the guy who has only a limited supply of tools and experience."

PM



Chotiner sprays windows and all, while Capotosto builds a shop in a wall.

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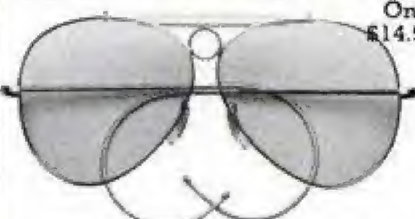
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LETTERS TO THE EDITOR



A spectacular rescue nevertheless

Helicopter pilot Don Usher certainly did a superb job of flying, as you reported in your story on last year's tragic air crash in Washington, D.C. (*The Most Amazing Rescue Of '82*, page 80, Jan. '83). Unfortunately, however, he shouldn't have had to be there at all. In fact, the powerful downwash from his rotor blades may have made it doubly difficult for the weakened survivors to hang onto whatever bits of floating wreckage there were.

It seems like a crude rescue effort. Where were the professional rescue units? Did someone order them to stay clear? I have a feeling that something

about the story hasn't been fully told.

R.S. LONG
FALLS CHURCH, VA.

Many emergency units were called to the scene, as our story explained, but rescue boats were hampered by heavy ice in the river, and firemen on shore were unable to heave lines far enough out into the water to reach the victims. Under the circumstances, it is truly remarkable that the U.S. Park Police helicopter team, though admittedly not equipped to handle such an emergency, was able to save all but one of those in the water.

Headlight hassle

In your article *Tomorrow's Car: PM Drove It* (page 77, Jan. '83), you called attention to the government's confusing and conflicting pronouncements on headlight covers. The situation is ridiculous, indeed, with one branch of DOT saying they're desirable and another saying they're illegal.

President Reagan once promised to get the government off our backs. Maybe he can get the stupid regulation banning the covers abolished if enough of us ask for it.

ROBERT D. SMITH
SWISHER, IOWA

Friendly computer advice

Your excellent article on computers (*The Five Friendliest Computers*, page 94, Feb. '83) was a big help. I had bought the VIC-20, but was unhappy with the instruction manual that came with it. I then purchased the two books you recommended. *Introduction to Computing . . . On the VIC* and *Introduction to Basic Programming*. Now I am very well satisfied.

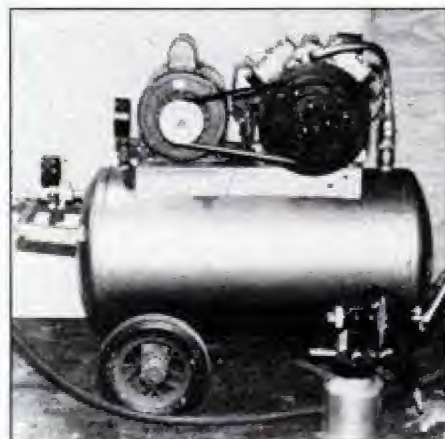
WALTER HASS
TAMPA, FLA.

A great article—the type of responsible journalism that keeps me a faithful PM subscriber.

RONALD L. KING
HOUSTON, TEX.

Compressor update

Here's a photo (below) of the PM air compressor I recently built from your plans (*Build Your Own Air Compressor From PM's Plans*, page 36, April '78). The plans were excellent and the compressor works very well.



PM's air compressor made by reader Coleman. The substitute works fine.

Incidentally, I had some difficulty locating the York compressor you specified, but a knowledgeable junk-yard operator understood what I needed and told me a Chrysler AirTemp compressor used in cars would work just as well. It does. Your readers may find this information useful.

HOWARD COLEMAN
INKSTER, MICH.

Thanks for the helpful tip. In using the Chrysler or any other make of compressor as a substitute for the York, one specification is important: It should have a displacement of at least 10.3 cubic inches to function properly in the PM design. Some automotive compressors may have less.

For others who may be interested, plans for building the PM air compressor are \$6.70 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

A scroll saw in every shop?

I'd like to compliment you on your fine article *Use Your Scroll Saw Like A Craftsman* (page 96, Jan. '83). I learned cutting tricks I never knew.

JAMES LEWIS
WEST SOUTHPORT, ME.

It was a great article; it made me want a scroll saw. But I have a question: Is a \$1,200 tool really for the average home workshop?

J. R. MULVANEY
ST. PAUL, MINN.

Scroll saw prices vary widely depending on capacity and convenience features. That \$1,200 is for a top-of-the-line model. Both Sears and Dremel sell smaller models for under \$100.

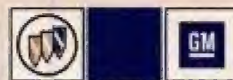
Not playing square

Thank you for the handsome stained-glass apple pattern (*Make This Classic Stained-Glass Light Box*, page 54, Aug. '82). The results were well worth the effort, but I think there was an error in your plans. If the top and bottom pieces are both 9½ inches long, the light box won't come out square because of differences in the rabbet depths. Right?

JIM McGRATH
WILMINGTON, ILL.

Our apologies to all who encountered this problem. The top was correctly indicated as 9½ inches long, but the bottom should have been shown a ½ inch shorter. Fortunately, no wood is wasted. Merely lop ½ inch off one end, recut the rabbet and the piece will fit properly.

PM



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That's how long Buick has been carrying on a love affair with the automobile. A devotion to bringing you comfortable, prestigious, quality cars. And that, of course, is exactly what Buicks have been down through the years.

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EST. HWY.	EPA EST. MPG
39	24

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Use estimated MPG for comparison. Your mileage may differ depending on speed, distance, weather. Actual highway mileage lower. Some Buicks are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your Buick dealer for details.

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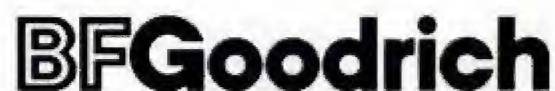
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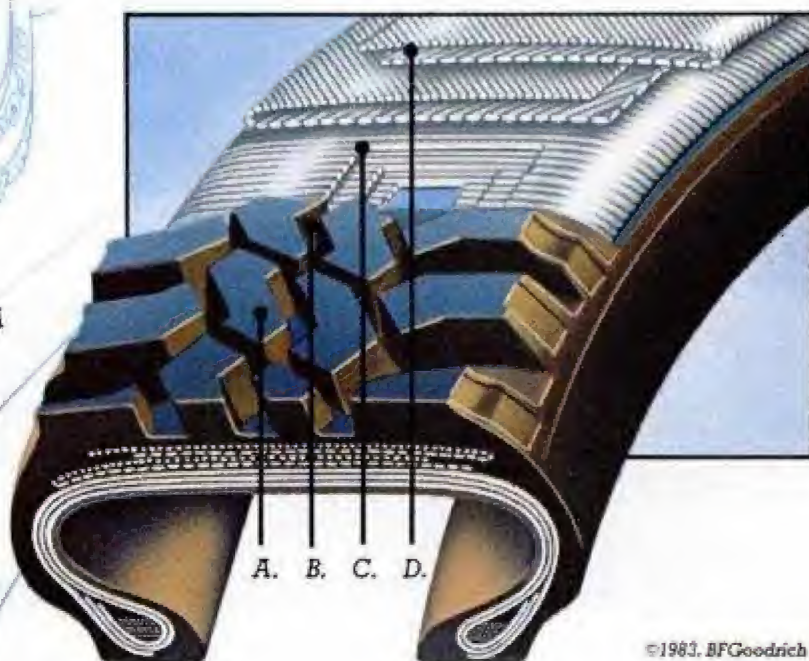
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- D. Four-ply DuroGard® folded belt system for durability in the critical stress areas.

IMPORTS & MOTORSPORTS



Opel Corsa

We all know the five General Motors divisions: Chevrolet, Pontiac, Buick, Oldsmobile and Cadillac. But GM has what I call a secret division. It makes cars in Europe and is known as Adam Opel AG. Rüsselsheim, Germany, is headquarters, but this GM-owned automaker produces parts and assembles cars all over Europe.



Newest Opel is the Corsa, available as sedan (here) and hatchback.

Commodore, Senator and Monza.

It was apparent that the Corsa has a certain magic from the stir at the Paris Auto Show last fall when the car was first seen.

Of the two body styles that are available, notchback and hatch, my choice is the hatch with its subtle, Quattro-like fender flares. Engine choices are 1.0, 1.2 and 1.3 liters. There are four equipment levels so you can set up a very plain or sporty little machine.

On the practical side, it has excellent interior room for a car its size (192.6 in. overall), low Cd and good fuel economy.

However, best of all is that dream-car quality we don't get enough of. I think of the Corsa every time I see a Chevy Chevette go by.



Corsa grille sports simple Opel emblem.

We used to get German Opels here, but they're no longer imported for Buick dealers' showrooms.

That is why we will never see the latest Opel, the Corsa. It's the new baby of the Opel range which includes the Kadett, Ascona, Manta, Rekord,



Corsa hatchback has subtle fender flares.

version is that it gets a new pair of bucket seats for better support. And, if you don't think driving this little screamer will provide enough of a thrill, you can order the seats equipped with Body-Sonic, a sound system that includes transducers hidden in the seats to transmit sound directly to your body.

Hey, is this a bumpy road, or is the music too loud?

Short March

Competing with Honda's City, the popular Japanese micromini, won't be easy.

However, Nissan will be trying with the introduction of its new, 143-in.-



Nissan March is new micromini in Japan.

long, one-liter, front-wheel driver called the March.

The 1,400-pound March is conventional in its appearance: It doesn't imitate the very upright stance of the City, but does resemble a scaled-down Mazda GLC. Like the City, it's not scheduled for export to the United States at this time.

Slicker City



A Honda City Turbo has a hood bulge.

If the seat mounts can take the g-forces, Honda's got another winner. The automaker has added a turbo to the 1.2-liter Four in its City model and boosted hp 50 percent to a fierce 100.

The City Turbo, recognized by its hood bulge, is the world's first mass-produced turbocharged car of such small displacement. Honda's small-engine turbo experience, you'll recall, started with motorcycles (see *Small-Bore, Blown And Beautiful: Riding Honda's CX500 Turbo*, page 90, Nov. '81).

Among the ways the City Turbo is different from the normally aspirated

U.S. GP X 4

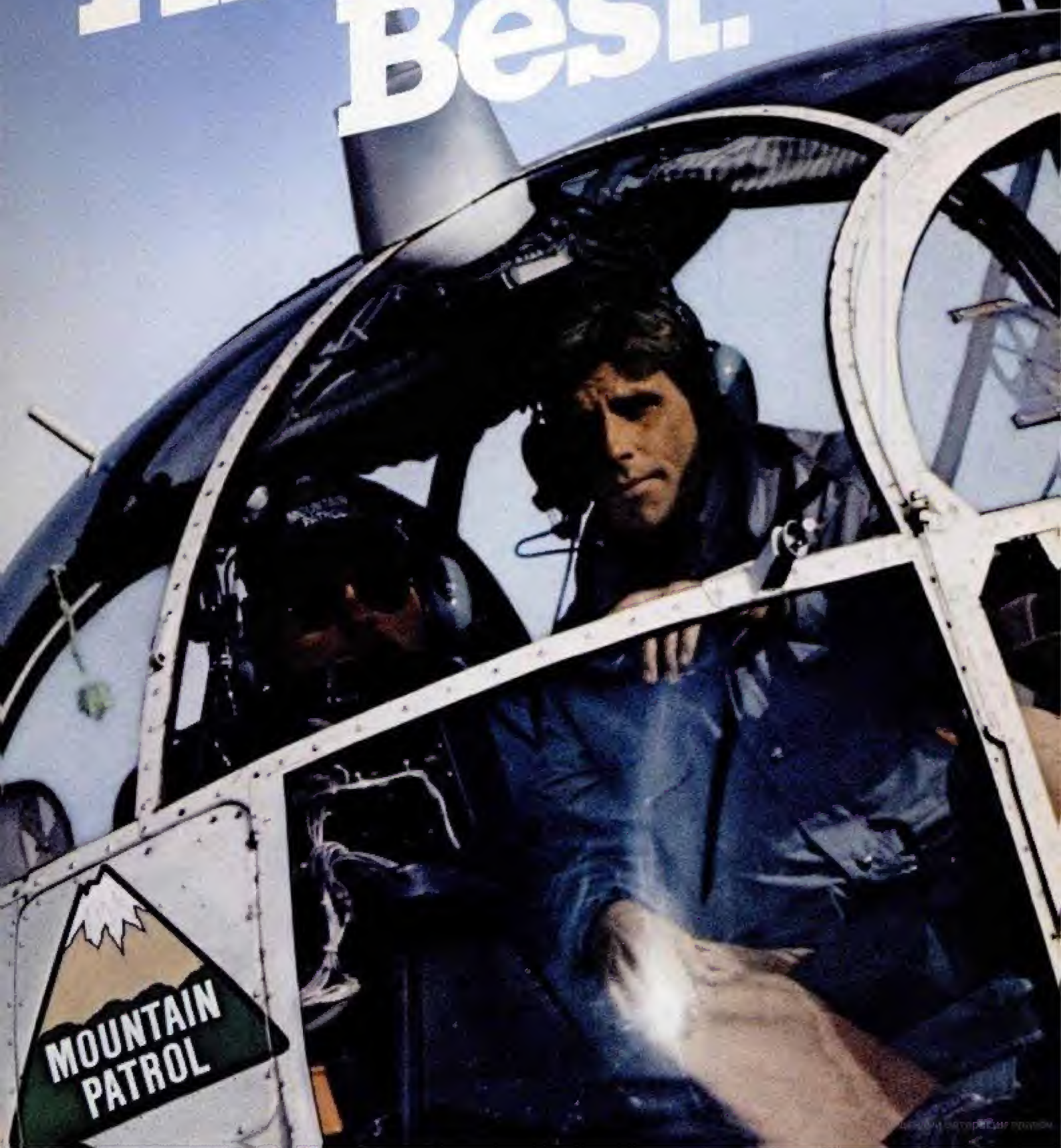
This year there will be no less than four Grand Prix races for Formula One cars in the United States. That's because the GP is coming to New York City.

The Big Apple race is scheduled for Sept. 25 on a circuit to be laid out around the lake at the old World's Fair grounds at Flushing Meadow.

As usual, the Las Vegas event will end the season—on Oct. 9. The Detroit GP is on the calendar for June 5, and, if you're reading this issue of PM early enough, you still have time to make plans for the first U.S. GP of the year, which is at Long Beach, Calif., on the 27th of March.

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ALL OUTDOORS



Sailboard sculling

Rowing is returning as a popular exercise sport, and a clever device to combine the activity afloat and ashore comes from Martin Marine, Goodwin Rd., Kittery Point, Me. 03905. Naval architect Arthur Martin calls it the Oarmaster, and with it almost any small craft using oars can be adapted for that most advanced of sculling pleasures, sliding-seat rowing.

The \$305 Oarmaster can be quickly mounted in a skiff, kayak or canoe, and the latest adapter kits allow it to be fitted on a sailboard for an additional \$30. One wingnut secures it. In the works is an attachment that can convert the Oarmaster into an indoor exercise rowing machine, as well. A Mini-Oarmaster has a fixed seat. Martin also supplies the Kittery Rowing Skiff (a \$285 kit for home building). Alden single and double rowing skiffs in fiberglass and Appledore Pod sailing skiff.



Any sailboard is turned into a rowing shell by adding a sliding-seat Oarmaster, a rig from Martin Marine.



The Oarmaster can also be mounted in a Kittery Skiff. This Martin Marine kit boat has curved ends for a smooth ride.

Sew-it-yourself boating

Here's an unconventional way of getting out on the water. Noted yachtsman Phil Reavis of Cherbourg, France, reports that local boatbuilders of Pondicherry, India, south of Madras on the Bay of Bengal, are still stitching up wooden craft, just as they always have. Planks are shaped with a keen eye to fit hull ribs. They are clamped and tourni-



Planks are stitched together to simplify hull assembly, with edge holes drilled to take laces that lash boat together.



Fishing craft in India's Bay of Bengal show construction shortcuts that modern do-it-yourselfers could use, as well.

queted into place with rope, and a series of holes are drilled along each edge. Hemp cord dipped in tar is used to lace the planks and lash them to the ribs and thwarts. Seams are caulked with pitch and hemp, fed in from the outside so that water pressure helps seal the joints. With modern synthetic cord for the lacing, plus epoxy and silicone for the seams, you could launch similar little dory-shaped boats. Don't forget your personal flotation devices.

More kick for kickers

Just announced for spring are new outboards from Evinrude and Johnson that are the most powerful production engines they've ever built. They're the Evinrude 2.6 Litre XP and the Johnson 2.6 Litre GT. Even though both new engines have the same displacement as the current top-of-the-line 235-hp. V6 motors, powerhead redesign with enlarged and reshaped ports, lighter reeds and relieved exhaust are report-



Evinrude's newest and fastest production outboard, the 2.6 Litre XP, is checked by racing ace Jimbo McConnell.

ed to increase power substantially. How much more horsepower, they're not saying. Largest production motor is probably still the special-order Mercury 300; and the fastest, the 3.5 Litre Johnson and Evinrude V8s. GT and XP motors of 150 hp will also be available.

Where to find out

Two of the best fishing books are a pair just published. *The Fishermen's Sourcebook*, by Bill Wisner, \$25, from Macmillan, is a treasury of salt and fresh water fish and fishing, tackle and lore. And for the most challenging of salt water sports, Mark Sosin and Lefty Kreh have recorded the special techniques in *Fishing The Flats*, \$14.95, from Winchester Press. **PM**

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PM ELECTRONICS MONITOR



Can CED meet the laser challenge?

Readers of this column are aware of the ongoing battle for standardization in the videodisc field between CED (capacitance-effect disc) and laser systems. A movie to one is an unreadable disc to the other.

One of the main advantages of the more costly laser system over the CED has been that laser-style discs could be interactive. Now, RCA has announced that it will soon offer an advanced CED player with the same capability.

Interaction is a result of the ability to go from one frame of a videodisc to another, without touching on the scenes in between. While this does

allow the viewer to skip back and forth to favorite parts of a classic film, this so-called *random access capability* has a far greater benefit. The random access allows for the design of discs that let the viewer become a real participant in an educational, or just plain fun, experience.

Interactive discs, so far available only on the laser machines, have run the gamut from teaching children numbers and magic tricks to demystifying complex gridiron plays for the video-equipped football widow. With an interactive disc, you can slow down the action, jump to a sequence further on

or perhaps go back and review a scene.

It is this interaction which has made the field of videodisc technology so wildly exciting and far more than just another way to watch a movie. And, in the past, it has been the main reason that the real excitement has centered in the laser camp.

The new, advanced CED players should be available "late in the second half of 1983." Until now, while the videodisc field has been far from moribund, it has not taken off the way some industry forecasters thought it might.

Now, with the advent of more inexpensive and interactive videodiscs, 1983 may indeed mark the true beginning of a new video age.

Tip-top Talaria

While there are many big-screen TVs on the market that deliver quality video at screen sizes of up to 10 feet, the real, wall-size television is not yet here. When you go from the big-screens to the great-big-screens (of 10 to 25 feet or more, measured diagonally), you begin to lose image quality, and brightness levels fall below even movie standards.

GE recently demonstrated its Talaria system, which is a method of projecting good-looking video on a 25-foot screen. But don't get your heart set on buying one unless you're far richer than most videophiles.

The cost is about 75 grand (yes, \$75,000) a unit. Now, when you throw in the cost of a popcorn popper, that's talking big bucks.

The system, which uses an oil film and one electron gun instead of three conventional cathode-ray tubes, is not yet near the retail stage. But GE says not to write off Talaria as a corporate plaything. It may be seen in some living rooms within the next five years, when they hope to have costs down.

Better sounding Beta

You don't often hear a video company going on about the audio part of its system, but then you don't often hear audio like Beta Hi-Fi. Sony's new system (to be licensed to other manufacturers) produces not only the usual

high-quality video, but audio that is just about the level of perfection achieved on digital sound systems. It's a breakthrough in both concept and technological implementation—and it should also prove one of the hottest new items in consumer electronics.

Old Beta-format videotapes will play on the new decks, but the thrill comes when you play back the new Beta Hi-Fi tapes. The sound track is recorded by the quickly rotating video heads instead of the usual stay-on-the-track

audio head. This results in the equivalent of a very, very fast tape speed. (Video quality remains the same.)

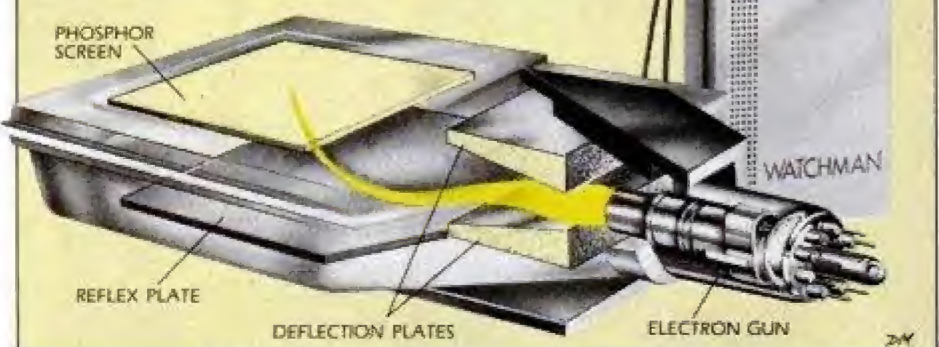
How good is good? The best home system of turntable, amp and speakers can deliver a dynamic range of slightly more than 60 dB (dynamic range being the difference between the loudest and softest notes). Beta Hi-Fi delivers 80 dB. Other specs are as impressive.

The new Beta Hi-Fi decks will hook to your stereo set or to stereo-capable TVs.

PM

As the ray is bent . . .

Sony's new Watchman TV set, which is about the size of a transistor radio, features a new-technology, flat-screen TV tube. The electron gun sends out a stream of electrons that is swept back and forth by deflection plates. But then, a reflex plate bends the electron ray upward to the screen above. This side-firing gun makes the flat screen possible. The picture's black and white, but color may be in the future.



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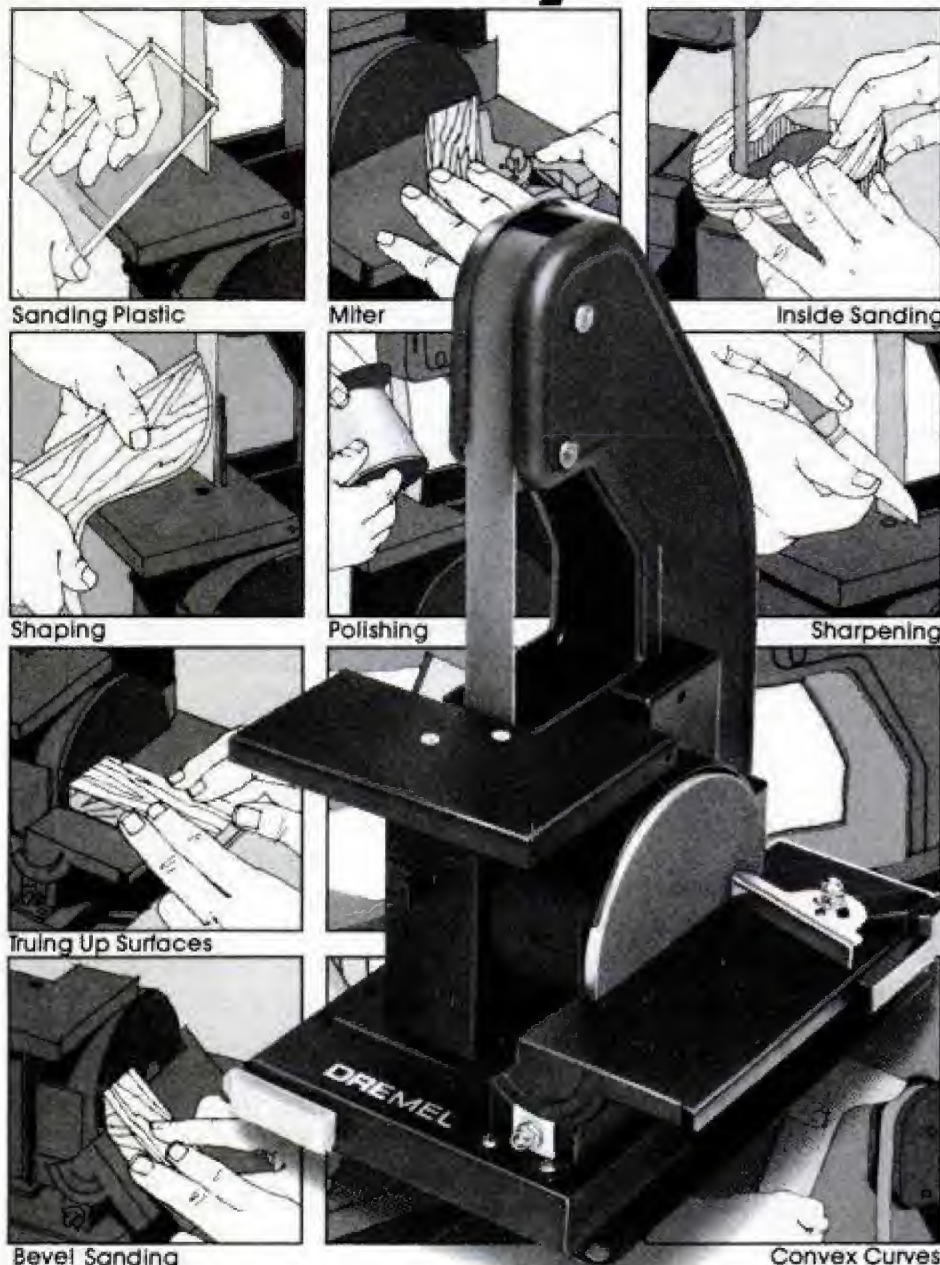
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HINTS FROM READERS

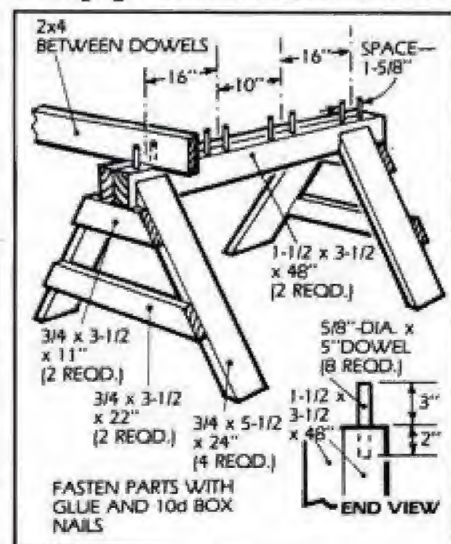
Hanger doubles as compass



To make a wood and wire locking trouser hanger into a large compass, clamp a sharp nail into one end of the hanger and a flat carpenter's pencil into the other. Space them so that they equal the radius of the desired circle.

—Ken Patterson

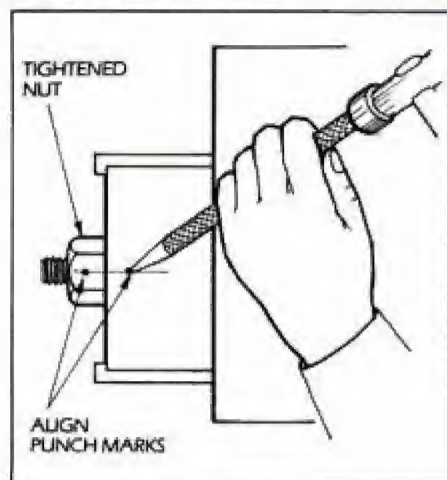
Cut plywood on sawhorses



A pair of sawhorses like the one shown lets you cut large sheets of plywood without a helper. With the support the sawhorses provide, you won't have to worry about plywood pinching the saw blade, resulting in possible kickback. Plus, the cut pieces remain aboard the 2x4s. Four 2x4s, each held by dowel pins spaced to permit the cutting of various width rip cuts, straddle the two sawhorses. Bore the eight dowel holes with an 1/16-in. drill bit. Fasten the legs and the four cross braces with glue and 10d box nails.—Bert H. Griesbach

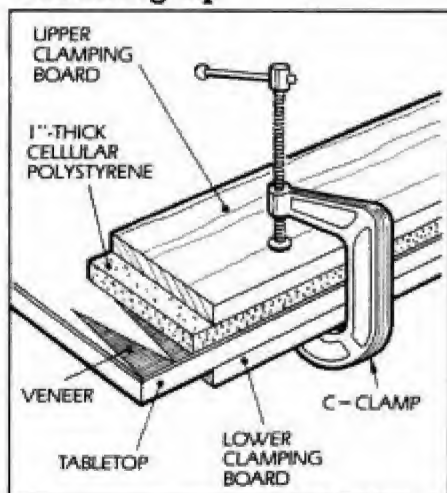
HINTS FROM READERS

Detect loose nuts



Here's a quick way to visually determine if a nut has loosened due to vibration or use. Strike a punch mark on the tightened nut and on a nearby surface. A loosened nut is quickly detected when the marks are misaligned. If you prefer, use dabs of paint for the alignment marks.—*Albert Rafanan*

Veneering tip



I use this improved clamping technique when simultaneously veneering small pieces of wood. First, cover the veneer with 1-in.-thick cellular polystyrene. Then place one rigid clamping board over the styrene and one under the tabletop. Position and tighten all C-clamps. The polystyrene conforms to any surface irregularities and allows clamping with sufficient pressure.

—*Hugh O. Sprague*

NEW

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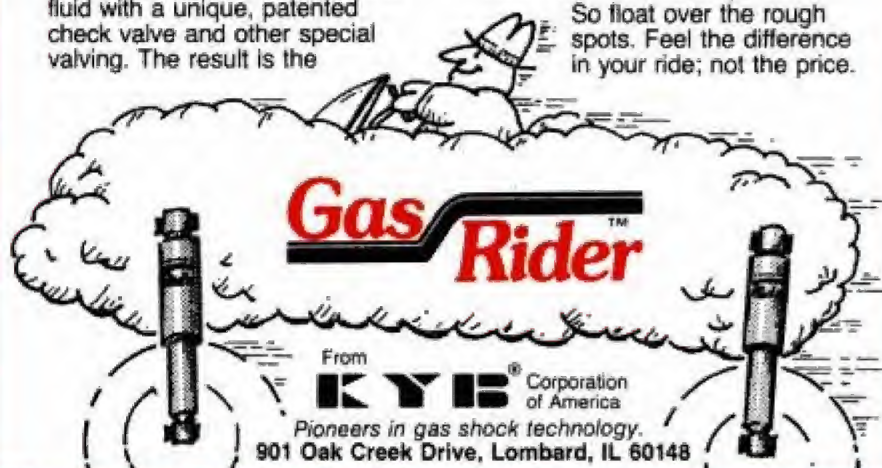
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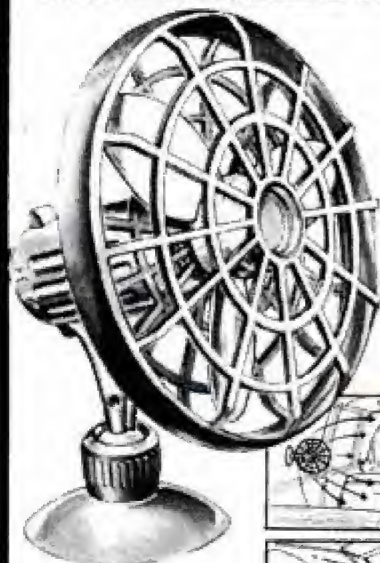
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CAR CLINIC



Eager Beavers

A few days after I bought a new 1982 Pontiac 6000LE, it developed an excessive engine vibration when wheels were turned to the right or left and when backing up, but also sometimes when driving forward. The dealer, in addition to other things, has installed vibration damper assemblies (part No. 14011736), but the trouble continues. Can you help me?—Lawrence M. Beavers, Tacoma, Wash.

Maybe—if your 6000 is equipped with a standard 2.5-liter electronic fuel-injected engine and an automatic trans-axle. Then, a different computer PROM (Programmable Read Only Memory),

which tailors Computer Command Control system performance to your car design, may be of help.

The new PROM, which has revised spark timing and slightly increased low-engine-speed calibrations, was issued three months after you bought your car. The increased engine speed helps reduce vibration, while the different timing prevents spark knock while you're accelerating at 40 to 55 mph.

The part number for the new PROM is 1226169. Ask your dealer to install it according to service bulletin 82-1-195. If your 6000 doesn't have the 2.5-liter EFI engine, this won't work.

Hope beats eternal

I own a 1975 Ford Granada with front disc and rear drum brakes. Since the car's early days, it's given me chatter and vibration in the front suspension when brakes are applied and this has become worse with age. Wheels have been balanced, aligned, rotated and replaced several times. Brakes have been overhauled and wheel bearings, shocks and tires changed. In other words, the suspension system and brakes have virtually been rebuilt. Nothing's helped. You're my last hope.—E.J. Corner, Kaplan, La.

Sounds like this could be a case of excessive rotor thickness variation (parallelism), which your brake overhauling hasn't resolved. A rotor turning machine that's been properly maintained and calibrated, used by a specialist, may bring rotors back to where they belong.

Other than this, there is a repair that could help. Although at first glance it may seem farfetched, my engineering friends at Ford agree it's worth a shot.

Some Granadas and Monarchs manufactured in the mid-1970s have a tendency to drift to the left. If repairs are not made to correct this, and the condition is allowed to progress, it could lead to "chatter and vibration."

The repair is to install a strut bushing kit (part No. D3D2-3A187-B) to bolster the front end. Also, have steering-gear preload tested. Then, adjust camber to

¼°, caster to ¼° and toe-in to ⅛ inch.

I'll keep my fingers crossed. Good luck.

Teaching a Lerner

Maybe you can tell me why my 1976 Toyota Celica runs roughly when the engine is cold, but runs like a charm once it's warmed up. When I bought the car used last year, I had it gone over from stem to stern, but the snort-

ing and bucking continue. Any ideas?—Bill Lerner, Columbus, Ohio

One good one. Toyotas built in 1975 and 1976 have a tendency to develop a leak in the auxiliary accelerator pump (AAP) diaphragm. When coupled with an open thermostatic vacuum switching valve (the valve is open only as the engine warms up), a leaking AAP can cause fuel leanness, which would make a cold engine run roughly.

To determine if this is so, start a cold engine and check inside the hose connected to the AAP, on the carburetor. If the hose is wet with fuel, the AAP diaphragm is leaking.

To install a new diaphragm, which you can get from a Toyota dealer, remove the three cover screws (four if the car is a Mark II) and pull off the cover. Place the textured side of the new diaphragm away from the carburetor. The tab with the squared-off end must be aligned with the bolt hole on top of the carburetor (with a four-screw type, it doesn't matter).

Install the spring in its seat in the center of the diaphragm. Then, replace the cover and tighten screws to between 0.9 and 1.5 ft.-lb. Overtightening could distort the cover and create another leak.

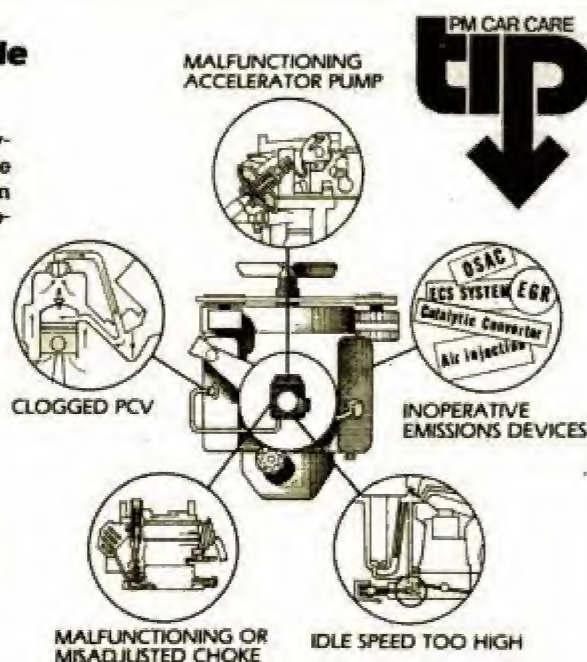
(Please turn to page 24)

Gas-saving guide

Here's a tip for those drivers in need of a quick guide to help them solve an excessive fuel-consumption problem. There are many causes.

At the head of the list is the way people drive. Then there is always the possibility of a fuel leak. But after these have been investigated, it's time to turn your attention to mechanical conditions.

Use this diagram as a guide. It shows primary causes of abnormal fuel consumption.



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Whether you buy or lease, see '83 Escort at your Ford Dealer. And remember, get it together—buckle up.

*Based on manufacturers' reported retail deliveries. Model-year 1982.

HAVE YOU DRIVEN A FORD...LATELY?



FORD DIVISION

CAR CLINIC

(Continued from page 22)

Red-flagging transmission

I want to warn owners of Plymouth Reliants and Dodge Aries about the chance of damaging a manual transmission if they continue driving their cars after the transmission has jumped out of gear. After my 1981 Reliant rolled up 18,000 miles, it started jumping out of third gear during deceleration, especially when descending hills. Sometimes, it would also jump out of second and fourth.

A dealer told me if I had continued driving the car, I could have ripped apart the whole transmission. The problem lies with a gear shift detent lever spring that breaks, I believe, because of a design flaw. The detent spring is riveted to a bracket and breaks off at the rivet hole because of insufficient edge distance on both sides of the hole.

Anyway the dealer pulled the broken spring and roller from the transmission where it could have caused damage far in excess of the \$108 it cost me. K-Car owners should be warned. Will you do it?—Albert F. Weiland, West Bend, Wis.

I've done it, thanks to you. But I want to add a few facts. The condition you

describe applies only to a limited number of 1981 Aries, Reliants, Horizons and Omnis equipped with the A-460 manual transaxle. The problem was recognized early in the production run, and design changes were made.

Jumping out of gear is one indication that trouble is brewing. Another is difficult shifting into third or fourth gear. If the problem hits an A-460 transaxle, the owner should go to a dealer as soon as possible for the repair outlined in technical service bulletin (TSB) 21-02-

81. Instructions tell the dealer to install a new selector shaft housing assembly (part No. 4030874)—the part that Weiland says is flawed.

Knocking around

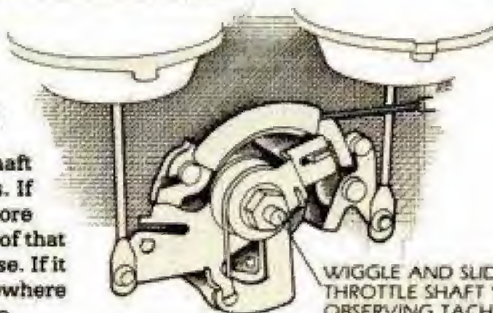
Since my 1981 Chevrolet Chevette turned 5,000 miles (it now has 10,000), there's been a severe and frequent spark knock. Upping fuel to a 91 octane level from the 87 recommended hasn't lessened the knock. The dealer says his

Don't get shafted

A worn carburetor throttle shaft is one reason why an engine may run roughly. However, you don't want to rip apart and overhaul or replace a carburetor unless you're certain it's causing the trouble. The fact that the shaft seems loose in the throttle body is not proof enough that damage exists.

To make sure you're not going to spend time and money, try this:

1. Connect tachometer.
2. Warm up the engine and let it run at idle.
3. Wiggle the throttle shaft and try sliding it sideways. If idle speed changes by more than 50 rpm, you have proof that the throttle shaft is too loose. If it doesn't change, look elsewhere for the cause of rough idle.



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test equipment shows all systems are adjusted to specification. What now?—J.W. Fugate, Warner Robins, Ga.

1. Pour in a can or two of GM Top Engine Cleaner and give it a week or two to work. This will get rid of carbon that may have accumulated and is causing premature ignition when it gets hot—a problem with engines used mostly for short trips. I would classify your Chevette, averaging 5,000 miles a year, as a short-range car.

2. Move ignition timing to 18° BTDC.

3. Pull the sparkplugs. Clean or replace them if tips are coated with carbon. Check that gap is 0.35 inch.

4. Check that exhaust gas recirculation (EGR) valve and thermostatically controlled air cleaner work properly.

Joint disease

My 1979 Honda Prelude has racked up close to 70,000 carefree miles, which speaks for its engineering and my fastidiousness about maintenance. It gets serviced by the book—many times, more often than the book recommends. That's why I'm concerned about a vibration on acceleration which has suddenly developed. Service departments of two Honda dealerships checked the car and found nothing. I'm enclosing a list of items inspected. Can

you find something that was missed?—Les Greenberg, Hollywood, Fla.

If the vibration shows up as a rotational oscillation in the steering wheel, the tires may be the cause. If it's more an instrument panel shudder, then the front-wheel drive (FWD) constant velocity (CV) joints may be damaged. Perhaps your mechanics didn't suspect them, because your CV joint boots are in good shape, but joint wear can take place anyway.

A common reason for joint failure is foreign material attacking joints through damaged boots. Watch for:

1. Slight humming. Joints may be starting to wear. Clean and lubricate them and install new boots to try and forestall failure.

2. Clicking on turns. Outboard CV joints may be worn or damaged.

3. Clunking on acceleration. An inboard CV joint may be worn.

4. Vibrating on acceleration.

Once the condition gets to points 2, 3 and 4, there's no way to save the joint. Replace it and the boot. **PM**

DO YOU HAVE A CAR PROBLEM?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be discussed in the column.

SERVICE TIPS

■ Chrysler says that tough N-1, 1-2 and 2-1 shifts in 1982 Ramcharger and B150 and B250 vans and wagons with overdrive four-speed transmissions may be caused by interference between the 1-2 synchronizer hub and sleeve. TSB 21-24-82 says to replace the 1-2 synchronizer assembly (part No. 4295288).

■ If there's a rattle from the parking brake handle of your 1982 Oldsmobile Firenza, the release rod and pawl could be loose. Cut a 1-inch thick by 1-inch in diameter piece of polyurethane foam. With brake handle engaged, push the foam in the open slot on underside of the handle, wedging it against the pawl. Make sure the parking brake releases.

■ If a dealer installed air conditioning in your 1982 Ford car or pickup truck, and you're experiencing evaporator freeze-up, the company says to have the dealer install a new electronic evaporator thermostat (part No. E2FZ-14A606-B). Article 82-22-1 of TSB 82-22 shows how.

■ In 1979, Toyota began coating the contact tips of distributor rotors with a substance that prevents ignition noise in car radios. Many good rotors have been replaced or filed off because the coating looks like corrosion. Leave it alone. If you have to replace the rotor because it's cracked, get a replacement from a Toyota dealer. It will be coated.

APPLIANCE CLINIC



Thermostat problems

I replaced the defective thermostat on my Frigidaire, model FD-14B-64, serial No. 56342, with a Gemline GC-400 universal therm. When set to the warmest position, the center of the box is about 40° F. and the bottom of the box and under the crisper drawers freeze. The circulation fan operates properly and the door gaskets are tight. What did I do wrong?—Arthur Leslie, Natick, Mass.

It sounds as if the insulation between the refrigerator and the freezer compartments may be wet. This could be caused by a crack in the refrigerator

liner or possibly a leaking drain tube. When this happens, the cold air in the freezer compartment freezes the water-soaked insulation. The cold temperatures permeate the bottom of the food compartment, causing food to freeze in the crisper drawers.

You might try defrosting the refrigerator completely by leaving it unplugged for three or four days. By defrosting the refrigerator for this length of time, it may help to dry the insulation. If this doesn't work, you will have to call a service technician in to replace the insulation.

Fixing a hair dryer

I have a Norelco "Gotcha Gun" 1200 hair dryer, model HB1777. My problem is how to open it for repairs. The air screens are partially plugged with fuzz and lint. Removing the end screws which hold the screen doesn't seem to help dislodge the screen. How can I remove them?—Marcel Edward, El Centro, Calif.

To clean the screens, you could use a brush or a can of compressed air. If you want to take the hair dryer apart, you will have to remove the screws which hold the unit together.

Your hair dryer housing consists of a two-part handle and a two-part, upper and lower housing. Remove the two screws in the front (inlet) screen; then remove the two screws in the back (outlet) screen. In the right handle section there are two small plastic plugs. Use an awl to remove them.

Under each plug is a Phillips screw. Remove both plugs and take out both screws. The handle will now come apart. Simply pry the two pieces apart with a small screwdriver.

Next, locate the final plastic plug and screw in the lower housing that must

be removed before both halves of the housing can be pried apart. When taking apart the handle and housing, be careful not to break the plastic clips which hold the halves together.

Note: Opening the housing of some appliances voids the warranty. Check the warranty of your hair dryer before you begin work.

Loaded with lint

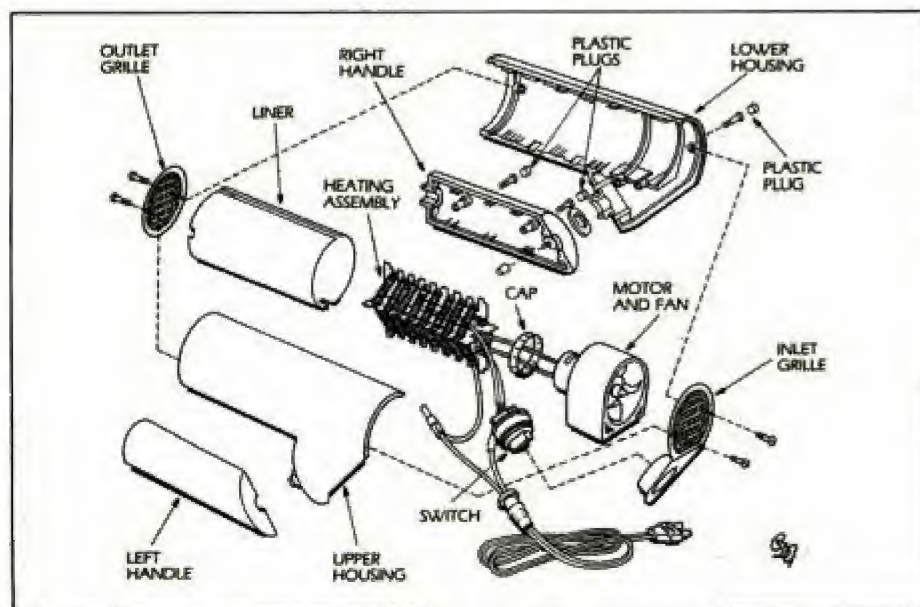
I have a General Electric dryer model No. DDC0580NLLWH, serial No. DA233774G. It doesn't exude any vapor or steam and there seems to be a lot of lint in the basket after each load. We've removed the pipe from the dryer to the outside two times and vacuumed it, but the problem remains. Hope you can help.—Mrs. E. Hooley, Riverside, Ill.

Sounds as if your problem is in the area of the blower wheel. Lint may have accumulated on it, or possibly a sock or washcloth may have fallen down into the blower wheel through the lint trap restricting airflow.

To check the blower wheel, remove the front of the dryer. However, first disconnect the power to the dryer. Now stand in front of the dryer and open the front door. Look up under the upper lip. Remove the four Phillips-head screws. When these screws are removed, the dryer top can be raised.

Next, while still in front of the dryer, reach down to the bottom left and right front of the dryer. Loosen the two 5/16-in. screws on the toeboard. Then remove the two screws at top left and right corners on the inside of the dryer. These screws hold the front to the cabinet. Close the door and lift the front up and off and set it to the side.

Now the blower wheel is exposed on the lower left-hand corner. Remove any lint or blockage. Use a vacuum to clean out the wheel and duct work inside the cabinet front which goes from the lint filter to the blower inlet. Reassemble the dryer. **FM**



To disassemble the Gotcha Gun housing, remove three plastic plugs and screws.

If you have a problem with any appliance, send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.



Radar warning. Hear the difference.

What Could Be Better Than Unbelievable Range?

By now, you've probably heard some tall sounding stories about how far away the ESCORT® radar warning receiver picks up radar traps. You know, the ones where they talk in miles instead of car lengths. The stories go on to say that ESCORT's superheterodyne receiving circuits provide as much X and K-band warning as you can possibly use, and then some. If you've never used an ESCORT, they may seem pretty far fetched, but most of them are true. Over hills, around corners, and from behind.

Car 54 Where Are You?

Maximum detection range is wonderful, but it's far from the whole story. In some ways, radar detectors are like smoke alarms; you want to make sure that you don't miss anything, but you don't want a lot of false alarms. ESCORT won't disappoint you. Beyond that, when a smoke alarm sounds off, the most pressing thing on your mind is: Where is the fire? Is it ahead of you, behind you, above you, or below you? In the same room, or at the other end of the house? Your senses can help you find fire, but, on the highway, you can't feel or smell radar. ESCORT is your sixth sense.

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ESCORT reports its findings straight to your ears in a way no other detector can match. Its vocabulary includes a Geiger-counter-like pulsating rhythm that relates radar intensity in a smooth, natural, and intuitive manner, making it easy to sense the distance to radar. It can tell you if radar is ahead of you, behind you, or even traveling along with you in traffic. ESCORT also speaks different languages for each radar band. Since the two bands behave differently, the distinctive tonal differences eliminate surprises. You'll even be able to tell "beam interrupter," "trigger," or "instant-on" type radars from other signals just by the sounds they make. Ditto for radar burglar alarms and door openers. ESCORT has a lot to say, and we've developed a new way for you to get acquainted quickly.

Play It, Sam

ESCORT's instruction book contains a wealth of information. Actually, it's the ESCORT user's Bible. But, the quickest way to become fluent in ESCORT's language is to play the Radar Disc on your stereo turntable. You'll hear firsthand how to interpret what ESCORT tells you in a number of situations. We now include this special Disc with every ESCORT so you can take a test drive as soon as you open the box.

No Stone Unturned

The ESCORT Radar Disc is the latest addition to a long list of standard features. We don't scrimp on anything. Here they are: ■ Patented Digital Signal Processor ■ Different Audio Alerts for X or K Band Radar ■ Varactor-Tuned Gunn Oscillator tunes out false alarms ■ Alert Lamp dims photoelectrically after dark ■ 1/64 Second Response Time covers all radar ■ City/Highway Switch filters out distractions ■ Audio Pulse Rate accurately relates radar intensity ■ Fully Adjustable Audio Volume ■ Softly Illuminated Signal Strength Meter ■ L.E.D. Power-On Indicator ■ Sturdy Extruded Aluminum Housing ■ Inconspicuous size (1.5H x 5.25W x .5D) ■ Power Cord Quick-Disconnect from back of unit ■ Convenient Visor Clip or Hook and Loop Mounting ■ Protective Molded Carrying Case ■ Spare Fuse and Alert Lamp Bulb.

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Car and Driver: "... The ESCORT, a perennial favorite of these black-box comparisons, is still the best radar detector money can buy ... All things considered, the ESCORT is the best piece of electronic protection on the market."

BMWCCA Roundel: "... The ESCORT is a highly sophisticated and sensitive detector that has been steadily improved over the years without changing those features that made it a success in the first place ... In terms of what all it does, nothing else comes close."

Playboy: "... ESCORT radar detectors ... (are) generally acknowledged to be the finest, most sensitive, most uncompromising effort at high technology in the field."

Autoweek: "... For the third straight year, no manufacturer has bettered the ESCORT's sensitivity ... the consistent quality is remarkable."

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DETROIT LISTENING POST



Cadillac and Olds

By now, the fantastic '83 Corvette should be on view in your local Chevy showroom. And soon the '84 Pontiac Fiero, another car that we have previewed in these pages, will be in production.

Now, it's time for an early look at the '84 C-cars (Cadillac deVille, Buick Electra, Olds 98) and an even sneakier preview of the '85 N-cars, designed to replace the current rear-drive Buick Regal, Olds Cutlass and Pontiac Grand Prix.

The deVille prototype pictured here is a fairly accurate representation of the Cadillac's front-wheel-drive luxury sedan scheduled for public introduction this fall (though insiders tell us it's better looking in person). There's a family resemblance to the smaller fwd A-cars that debuted a bit over a year ago, but the C's are not stretched A's. They're all-new bodies on a new 108-in.-wheelbase platform. Suspension is fully independent, with MacPherson struts and disc brakes at all four corners, and rear-seat room is said to be substantial.

The Cadillac versions will offer that division's lightweight aluminum 4.1-liter V8, but the Buick and Olds will be powered by a standard Buick-built, 3.0-liter, port-fuel-injected V6. The Olds-built 4.3-liter diesel V6 will be optional. All engines, of course, will be transversely mounted to save space and weight, and all will be coupled to four-



The '84 Cadillac deVille (top) will have front-wheel drive and will be powered by a 4.1-liter V8 engine. The '85 N-bodies (Cutlass, Regal and the Grand Prix shown above) will be based on the current J-cars (Cimarron, Cavalier, 2000 and Skyhawk).

speed overdrive automatic transaxles. With base weights around 3,200 pounds, both performance and fuel economy should be more than respectable.

The N-bodies will be coupes at first (probably followed by four-door versions a year later), and they will be derived from the current J-car—just as the excellent mid-size A-cars are built

on stretched and much improved compact X-car platforms. Interestingly, it seems there will not be a version for Chevrolet Div., which will stick with its rear-drive Monte Carlo until an A-based replacement (or some other alternative) can be developed. This will allow N-car production to be handled by a single factory, at least until GM sees how well first-year sales go.

'83 or '84 Corvette?

Last month we called the new Corvette an '83 model in our driving report and on our cover. Well, it has turned out to be an '84 and there will be no 1983 model of the Vette. The 1982 models will be available right up until the time you can buy an '84.

Prior to the car's introduction, virtually all the descriptive information coming out of Chevrolet pegged the car as an '83. It was also listed as an '83 in the Motor Vehicle Manufacturers' Assn. (MVMA) specifications issued to us at the press preview. It was after we went to press that the model year became officially 1984.

So, just to set the matter straight, the



Here's the '84 Corvette coming at you in '83. Remember, it's an '84, okay? Okay.

new Vette's an '84; all the Vehicle Identification Numbers (VIN) will call it an '84; dealers will be selling it as an

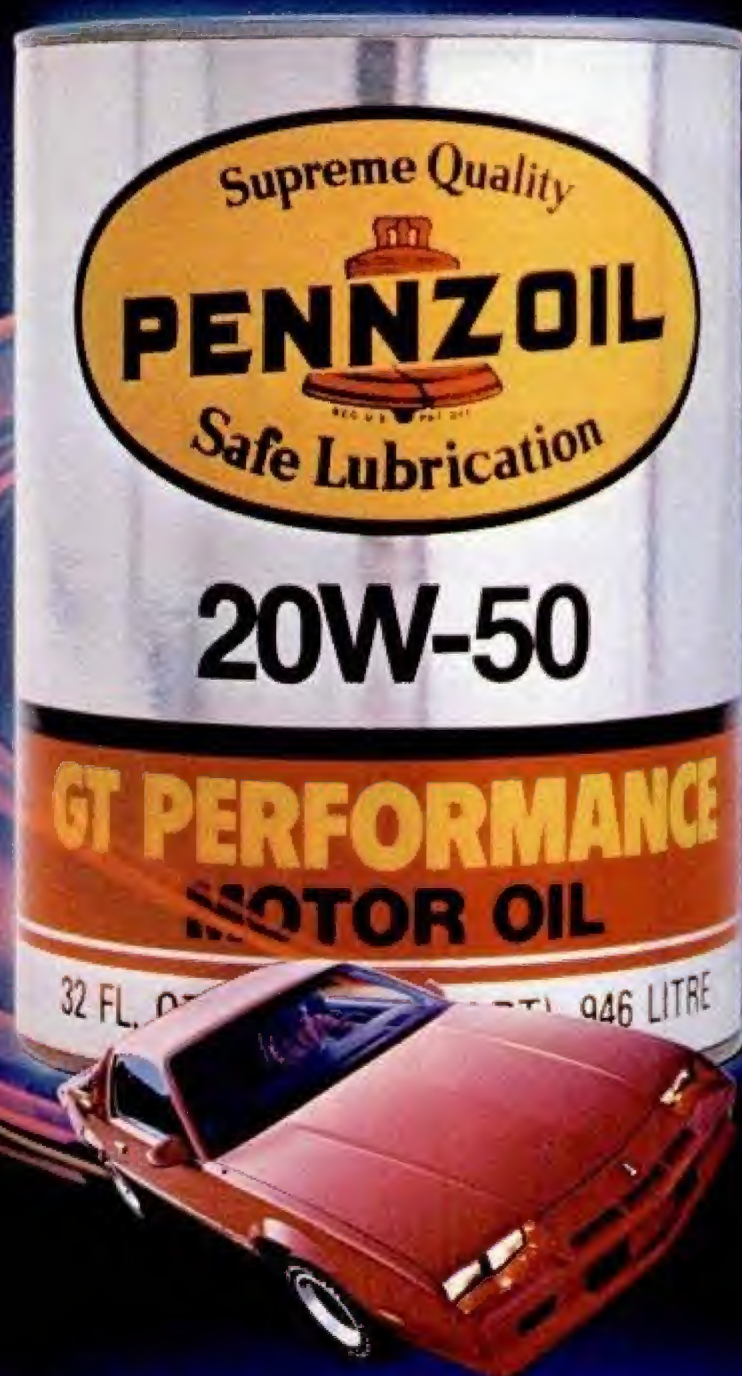
'84 and Chevrolet wants you to know that it is an '84. Whatever year you call it, the new Corvette is still the best car that ever came out of Detroit.

GM racing revival

General Motors has long been criticized for dragging its heavy corporate feet on performance and motorsports while its competition (primarily Ford and the better imports) have stolen away much of the excitement-starved American "youth" market. Now, finally, it's starting to do something.

First, the corporation has lifted its 25-year ban on racing—to a point.

(Please turn to page 30)



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Pennzoil GT Performance Motor Oil

Extra Weight for Tough Protection

DETROIT LISTENING POST

(Continued from page 28)

Only four divisions are allowed to participate officially: Chevrolet, Pontiac, GMC (Truck) and AC Spark Plug. And only with certain products: Corvette, Camaro and light trucks for Chevy; Firebird and Fiero for Pontiac; light trucks for GMC.

This specifically excludes the other three car divisions, even (unbelievably) Buick, which has invested much sweat, time and money in development of high performance components for its V6 engines. It also leaves out GM's cur-

rent rear-drive G-car intermediate coupes (Regal, Cutlass, Grand Prix and Monte Carlo), which have dominated the NASCAR Grand National stock car circuit for years.

Will the GM divisions have to abandon all involvement in NASCAR, handing the series on a plate to the sleek, new, factory-backed Ford Thunderbirds? Or will they carry on business as usual out their back doors? Will Buick continue V6 competition engine development? What about the Turbo V6

Indy-car engine programs at both Buick and Chevrolet? Sounds like a bad soap opera, you say? Stay tuned.

Meanwhile, on the street performance front, all sorts of exciting things are going on deep in the bowels of all five car divisions:

Chevrolet promises a much-needed power transfusion soon for its Camaro Z-28: perhaps the 200-hp, 5.7-liter Corvette engine, but more likely an HO version of the current carbureted 5.0 V8. Corvette-type independent rear suspension is also a possibility. Several other performance projects, including a supercharged, 2.0-liter, J-car engine, are keeping Chevy's development engineers busy.

Pontiac recently unveiled its 10,000th experimental engine, which just happened to be a turbocharged, fuel-injected 1.8-liter ohc Four like the one being prepared for a killer STE version of its '84 2000 (J-car). Also under development is an aluminum-block, 2.9-liter Turbo V6 for the future Firebird Trans Am.

Both Buick and Cadillac will market versions of the former's much-discussed luxury sports car, possibly by the '86 model year. Some say these will be mid-engine convertibles; I'll buy the ragtop part, but not the mid-ship engine—too impractical. At any rate, they'll be spinoffs of the '86 downsized front-wheel-drive E/K-car (Eldorado, Riviera, Toronado, Seville) with injected V6 power and \$30,000-plus stickers. Also—get this—Cadillac's been testing a Cimarron (J-car) powered by a V6 derived from its 4.1-liter aluminum V8.

Hotrod Lincolns, Escorts

Not that Ford is standing still, you understand. Inside word from Dearborn is that both the Lincoln Continental and the coming '84 Mark VII coupe will get optional performance packages.

These will include super suspensions, wheels, tires, brakes and—are you ready?—the 177-hp, HO, 5.0-liter V8 straight from the company's ultra-hot Mustang GT and Capri RS. Look out Mercedes, BMW and Jaguar!

The new Mark VII, considerably smaller and prettier than the brick-shaped Mark VI it will replace, seems cut from the same aerodynamic cloth as the '83 Thunderbird. It's very similar in appearance to last year's striking Continental Concept 90 show car.

At the other end of its size and price scale, Ford plans to one-up VW's delightfully quick Rabbit GTI next year with turbocharged Escort GTs, EXPs and LN-7s.

FM



Stanley's new "Flip Drive"™ Ratchet lets you change ratcheting directions with one hand.

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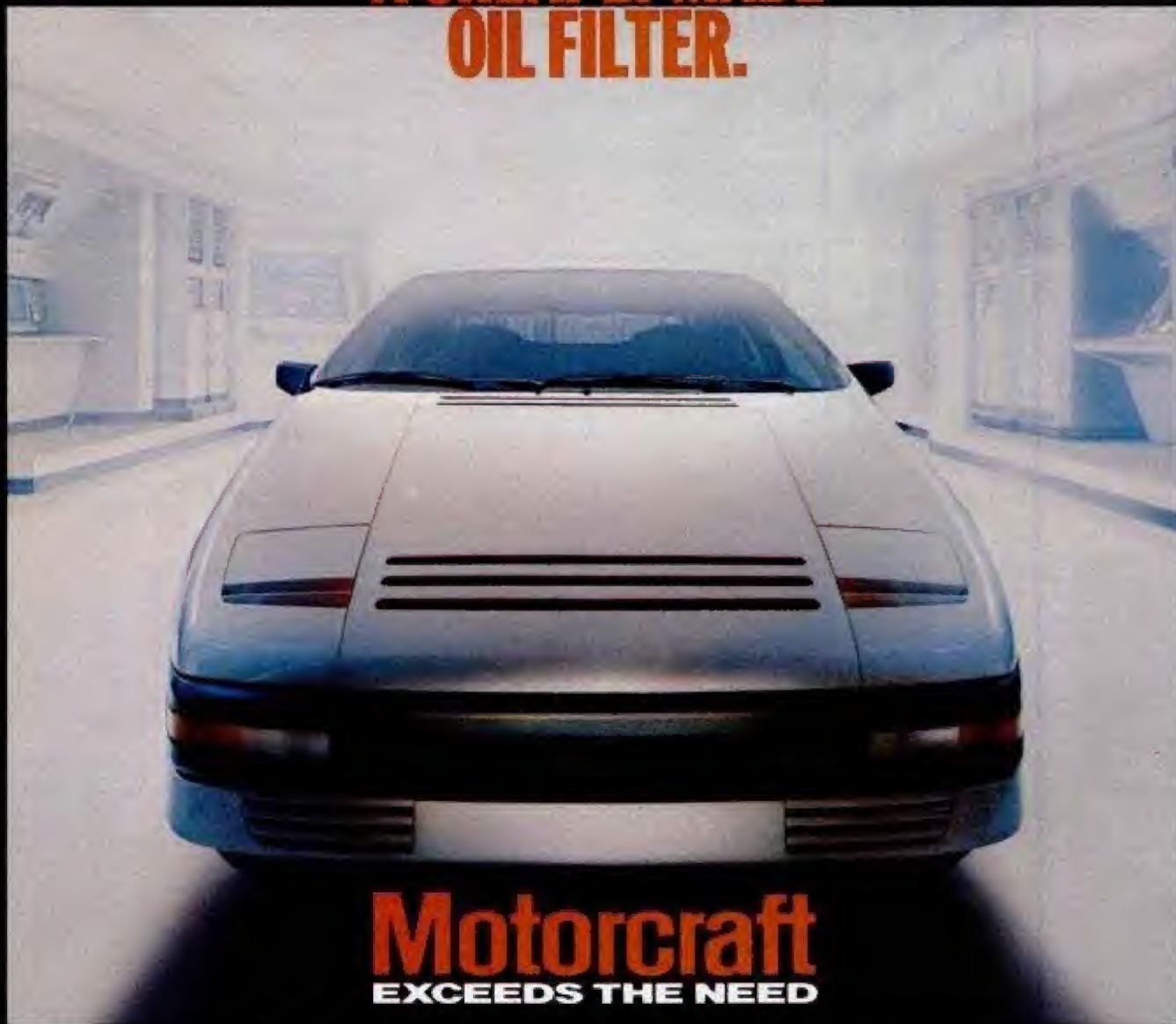
The Workmaster line delivers the selection you'd expect. All the most needed drive tools, sockets, wrenches and accessories. And a complete line of sets for a wide variety of jobs. All in reusable packages for

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Behind the letters

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Many people are curious as to what film-speed abbreviations stand for. The letters ISO are the International Organization of Standardization; ASA is for American Standards Assn. and DIN stands for Germany Industry Standard. You won't take better shots, but you'll be informed.—Robert Hertzberg

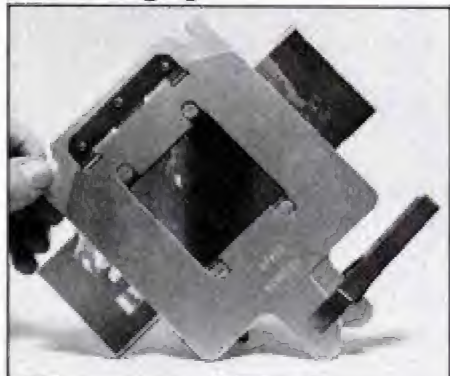
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—Robert Hertzberg

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If you've ever wanted a third hand to put a film strip in a negative holder and place the holder in an enlarger's jaws, here's a way. A spring-type clothes pin helps to keep the negative holder closed.—Robert Hertzberg

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Front-mount mower
for mini-dozer

Struck-Kit now offers a front-mount, heavy-duty mower for their Mini-Dozer Crawler tractor. The all-gear-driven mower features a new safe start and quick-braking system. The safe start will not allow the tractor to be started unless the mower is in neutral. Struck-Kit claims that the quick-braking system will bring the mower to a stop within three seconds of being shut off.

The front-mounted, free-floating design permits mowing under bushes and low

tree branches. The free-floating design also allows the mower to follow uneven terrain smoothly without scalping the high spots or flying over low areas.

The Mini-Dozer tractor (models from \$1,000 to \$2,400) and its front-mount mower (\$500) are available through the manufacturer. For more information, contact Struck-Kit, Struck Lane, Cedarburg, Wis. 53012.



New tool for quick repairs

Skil Corp. has introduced a rechargeable, cordless, reversible screwdriver said to possess the power of larger heavy-duty models. The Model 2000 (\$39.99) weighs only 1½ lbs., yet Skil claims a three-hour charge of the nickel cadmium batteries provides enough power to drive 200 ½-in. No. 5 wood screws into pine. Its triple reduction gearing is capable of driving up to No. 12 wood screws. The Model 2000 comes with one slotted and one Phillips screw bit, but will accept any ¼-in. hex bit. For details, contact Skil Corp., 4801 West Peterson Ave., Chicago, Ill. 60646.

Cutters for smaller shapers



Rockwell International has added more than 30 new profiles to its existing line of tungsten, carbide-tipped shaper cutters.

The cutters will fit ½- and ¾-in.-dia. spindles (four exceptions fit 1- and

1¼-in.-dia. spindles) found on smaller, more affordable shapers. The cutters include straight, bead, ogee, sash and various door lip and panel-raising profiles, plus three cabinet molding sets.

Prices for individual cutters range from \$57 to \$140; cabinet molding sets (each with six cutters) are \$295.

For more information, contact Mat Patulski, Rockwell International, Power Tool Div., 400 North Lexington Ave., Pittsburgh, Pa. 15208.

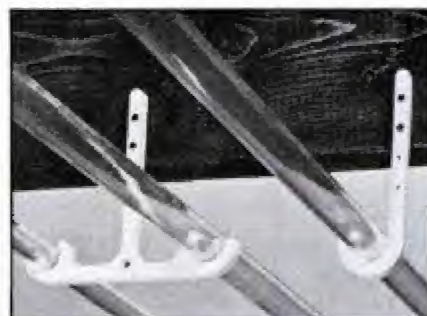
Quiet plastic pipe holders

A plastic device for installing water or drain pipes has been developed by J-Hook Inc. It's made of ABS plastic. The maker claims that J-Hook's tight grip can prevent the noisy banging

of loose pipes and will not distort even at 250° F.

J-Hooks are available in ½-, ¾-, 1-, 1½-, 2-, 3- and 4-in. dia. Single-hook models range from 40 to 70 cents each; double-hook

models from 60 to 90 cents each. Available at hardware stores and plumbing supply houses, they're made by J-Hook Industries Inc., 4425 44th St. S.E., Box 8637, Grand Rapids, Mich. 49508.



New UDS Computer Telephones To Be Sold For Only \$10 Apiece In Mammoth Publicity Drive

*All who wish to apply for a new Computer Telephone
should write to the company address below
before Midnight, June 30, 1983*

NEW YORK—One million new UDS Computer Telephones with electronic memory and pushbutton dialing will be sold as part of a publicity campaign for only \$10 apiece to the first one million persons who write to the company address before Midnight, June 30, 1983.

These are the same famous UDS Computer Telephones to be nationally publicized in *The New York Times*, *TV Guide* and other leading magazines, with *electronic re-dial* (which automatically keeps re-dialing busy or unanswered numbers till they answer) and *electronic "mute"* (which lets you talk "confidentially" without putting your hand over the mouthpiece.)

Only half the size (and half the weight) of standard phones, they also have adjustable electronic ringers, which means you can turn them "off"—for complete silence—whenever you don't want to be disturbed. And when you finish your call, you don't have to bother hanging up—simply put the unit down (anywhere you please) and it will hang *itself* up, automatically.

These new UDS Computer Telephones are FCC-approved and require no installation. Simply plug them into the same modular outlets as your present



rotary dial or pushbutton phones. *You can then legally return your present phones to the phone company, saving yourself up to \$8 a month (or over \$90 a year) for each phone you return.*

These new UDS Computer Telephones will not be sold at this price by the company in any store. To obtain one at this price, apply in writing to

the company address no later than Midnight, June 30, 1983.

Each phone carries a full one-year money-back guarantee, and the company will replace it, free of charge, if it ever fails to function. There is a limit of two (2) phones per address at this price, but requests which are mailed early enough (before June 22) are permitted to order up to 5 phones.

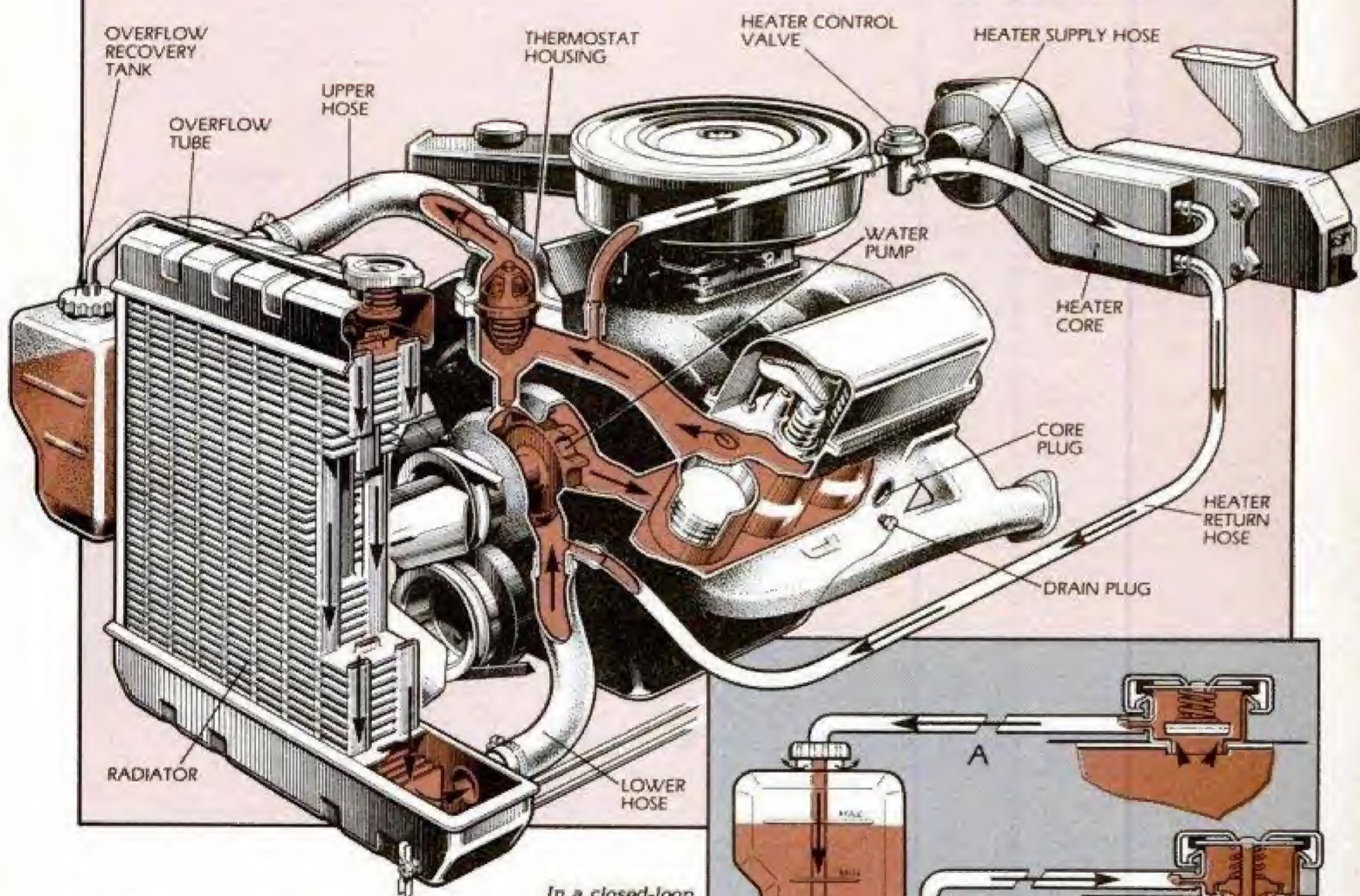
To apply for a new UDS Computer Telephone, mail *this original printed notice* together with your name and address and \$10 for each phone desired. Add \$2 shipping and handling for each phone you are requesting. Mail to: **Carter & Van Peel, UDS Computer Telephone Offer, Dept. 114-6, Box 1220, Westbury, New York 11595.**

(V21410)

Troubleshooting Your Cooling System

BY MORT SCHULTZ

PART 1



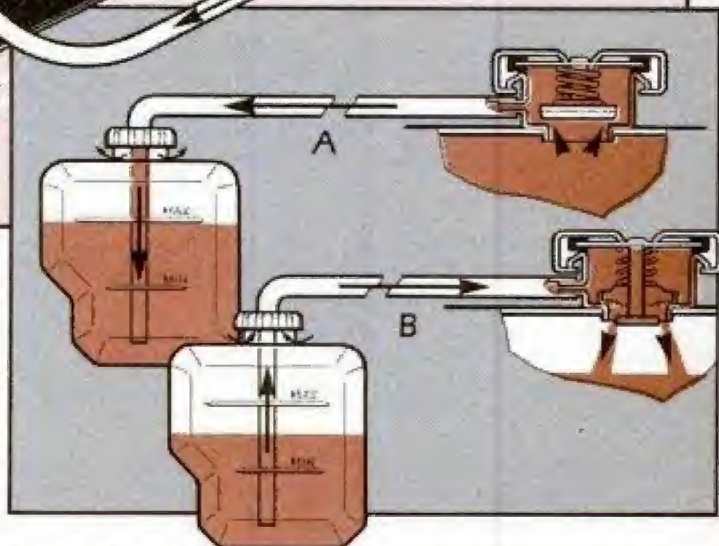
We estimate that 3 million motorists are marooned each year by disabled cooling systems. You don't have to be among them.

Cleaning and refilling cooling systems is important, of course, but it's no guarantee that cooling-system parts won't fail. So, if you don't want to wind up waiting for a tow truck, make sure you include the inspection of parts in your regular maintenance schedule.

Those parts you can get at easily, should be checked frequently. The others you can test less often.

However, every cooling-system part should be examined at least once a year. This means hoses, radiator pressure caps, thermostat, fan and drive

In a closed-loop overflow system, excess pressure is blown off into the reservoir bottle (A). Vacuum created when engine cools draws the fluid back into the radiator (B).



belts, radiator, water pump and engine drain plugs.

Start with hoses

Hoses will fail faster than any other cooling-system component. Fortunately, they are visually in full view and easy to inspect.

Although hose life expectancy is approximately 25,000 miles, don't take

chances. Inspect your hoses every couple of months.

Just squeeze 'em, but do so with the engine turned off and cold. If a hose isn't firm and doesn't regain its shape as soon as you release pressure, replace it. Scrap a hard or mushy hose, one that shows cracks under pressure or one that's swollen.

Don't forget to include inlet and out-



To remove a stubborn hose, slit it with a blade. Take care not to gouge connector.

let heater hoses in your inspection. They're as much a part of the cooling system as the upper and lower radiator hoses. Some cooling systems also have a thermostat bypass hose jutting off the water pump. Check this, too. Remember—if any hose suddenly splits, the cooling system will lose most or all of its coolant and shut the vehicle down.

Tips to ease replacing hoses

Replacing a bad hose requires that you drain the radiator below hose level, loosen clamps and twist the hose off its connectors (radiator necks). You may encounter resistance, but don't use excessive force or a prying tool. You might damage a connector, and that could result in a major repair.

So, slit the hose lengthwise at three or four points. Use a sharp knife, such as a drywall knife. Be careful not to slice into the connector. Then, peel the hose off.

As for old clamps, throw them away. New clamps are inexpensive.

Worm-drive clamps are easiest to work with, but they do have a tendency to vibrate loose; so be sure to tighten the clamp screws every so often.

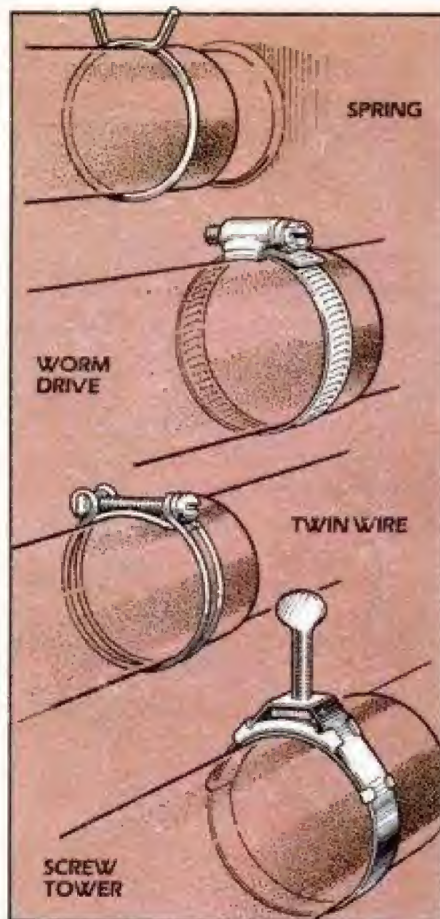
Replacement radiator hoses are molded or flexible (accordion-type). Although they're a bit more difficult to install, use molded hoses; we think they hold up better.

Generally, replacement hoses come in one size—long. You usually have to cut them to fit between connectors. If the hose is too long, it will peak and may restrict the flow of coolant.

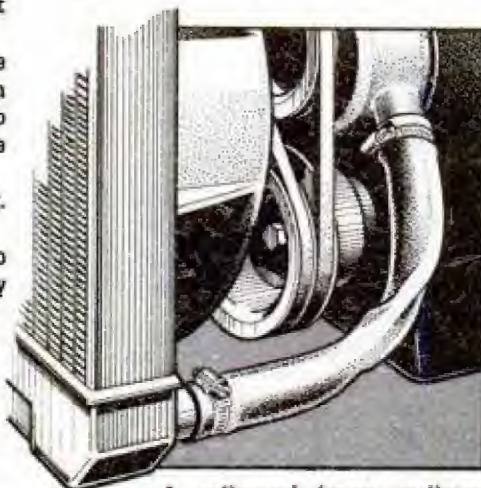
To cut a new hose, measure the old hose before you throw it away. Mark off the length on the new hose and use a sharp knife to make the cut.

This isn't as simple as it sounds, because you want a square end. If the cut end is slanted, the hose may not fit securely on the connector.

To get a square cut, slide the clamp on the new hose. Place it so that one side is on the measurement mark. Tighten the clamp. Now, use the side of



Of the various types of hose clamps, the easiest one to use is the worm-gear type.



A collapsed lower radiator hose is the result of a failed stiffening spring. When you replace this hose, make sure that the spring is of the right type and length for the application.

the clamp for a guide as you cut the hose.

There is a way to make the installation of a molded hose less of a battle. First, use a wire brush to clean off the connectors. Then, coat the connectors with a water-proof sealer. Do not put any sealer inside the hose. It may flake and fall into the radiator.

Now, slip the clamps onto the hose and dip the ends of the hose in coolant

(ethylene glycol). The coolant acts as a lubricant and makes it easier for you to push the hose fully onto the connectors.

Finally, slide the clamps into place. Generally, inlet and outlet connectors of the radiator have a round protuberance. Make sure that the clamp is behind this bead. In any case, place the clamps about $\frac{1}{4}$ inch from the ends of the hose.

Tighten the clamps snugly, but don't use excessive force. If you do, you could deform the connector. Refill the radiator, start the engine and make sure that no coolant is leaking from around the ends of the new hose.

That lowdown lower hose

That lower radiator hose is a sneaky devil. It has a coil spring inside that can lose tension. This causes the hose to collapse at higher engine speeds, cutting off the flow of coolant. The result is overheating on the highway.

To make sure this won't happen, have someone start and accelerate the engine as you watch the hose. (Keep away from the fan, belts and pulley.) The hose should stay in shape. If it flattens, replace it.

The lower radiator hose can cause another problem if you have to replace it. Make sure the one you get has a coil spring in it. Lower radiator hoses are entering the market without springs. This isn't a problem if you're replacing the old hose, because it's cracked or leaking. Just transfer the spring from the old one to the new hose.

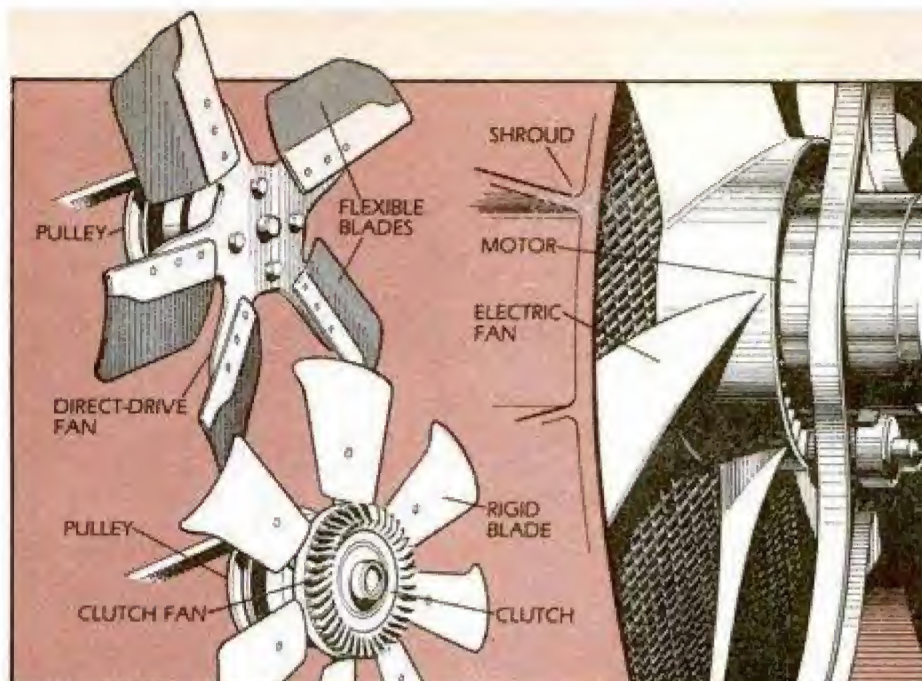
However, you can't do this if you're replacing the hose because of a weak spring, so keep looking until you find a new hose with a spring. If you can't find one, go to an auto salvage yard and get one off a junker. Just make sure it's the correct length.

Keeping the pressure on

The radiator pressure cap is reliable, but it doesn't last forever. It has two important jobs. If it fails to do them, the cooling system will overheat.

One job is to seal the cooling system. The cap gasket pushes against the radiator filler neck to do this. Sealed, the cooling system builds up pressure that raises the boiling point of coolant. For example, the boiling point of a 44 to 56 coolant-water mixture is raised approximately 50° at sea level, and a higher engine operating temperature is more efficient.

The second job the radiator cap has is to release pressure when it reaches a critical level. Depending on the cap design, a pressure vent, cap gasket or a



The three types of cooling fans are direct-belt-driven, clutch-belt-driven and electric-motor-driven. All three can be tested, using different procedures for each one.

rubber washer around the rim of the cap will move when the pressure gets too high, and pressure is released.

In older cars, this pressure is released through an overflow hose that extends down the side of the radiator. As it's released, some coolant flows from the radiator through the overflow hose and is lost.

Newer cars are equipped with sealed overflow systems. As the pressure is released, the coolant flows from the radiator through the overflow hose into a plastic tank. When the engine cools, vacuum created in the radiator draws the coolant back into the radiator.

Capping it off

Here's what you should know about servicing pressure caps:

- Never remove one from a hot radiator. As careful as you are, there's always a chance that hot coolant will gush and scald you. Burns are the main injury suffered by those who work on cars.

- Wash the cap in water and examine the gasket or gaskets. Whenever a crack is found, replace the cap.

- If the cap has locking tabs, be positive that neither one is bent. If a tab is bent, replace the cap.

- Press down on the spring. It should offer strong resistance. If there is but slight resistance, replace the cap.

- Attach the cap to a cooling-system analyzer and pump up the pressure so that the dial records the pressure stamped on the cap body. If the pressure falls off rapidly, the cap is not functioning properly. Replace it.

Analyzers (pressure testers) are sensitive to small air leaks which can cause the pressure to drop off slowly. Don't be fooled and replace a good cap. If

you're not losing coolant, keep the cap in service.

- If a replacement is called for, buy a new cap that's designed for your cooling system. Doing otherwise will result in a loss of coolant and overheating. Furthermore, aluminum radiators require the use of aluminum radiator caps to prevent galvanic action that results in corrosion.

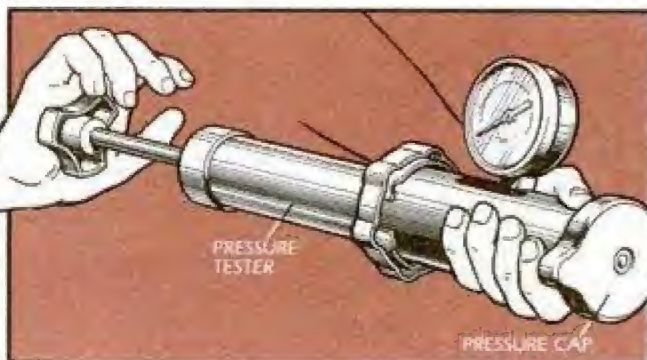
- Inspect the radiator filler neck to check for bent tabs and rim. Also, make sure that the neck is firmly soldered to the radiator tank. A damaged filler neck will have to be replaced.

- Replace the overflow tube and/or plastic tank if either one is not in good shape.

- Finally, in many cars with plastic coolant recovery tanks, radiator caps have to be secured so that an arrow or mark on the cap will line up with the overflow tube. This is your assurance that the valves are in place to permit the release of pressure and syphoning.

Pressure-testing the system

With the engine cold and turned off, remove the radiator pressure cap. Make sure the radiator is filled; then wipe the filler neck clean.



Cooling-system pressure analyzer is a must for checking the integrity of the system and radiator cap. To test the cap, attach tester and pump the handle until pressure on the gauge matches that stamped on cap.

Attach the tester securely to the filler neck and pump up pressure until the tester gauge reads the level at which the cooling system is rated. This rating is stamped into the top of the radiator cap.

Watch the gauge needle. If it falls, keep the system under pressure and examine for coolant leaks.

Suppose the needle drops, but you don't find a leak. What do you do then?

Loosen the tester and start the engine. Let it run until it reaches normal operating temperature. Now, tighten the tester.

Caution: Be careful when doing this test. With the cooling system tester connected and the engine running, pressure builds up quickly. Don't let pressure exceed 20 p.s.i. When it starts coming close, loosen the tester carefully. Hot coolant may spew out, so be ready to jump back.

If the needle fluctuates, there's probably a combustion leak because of a bad head gasket.

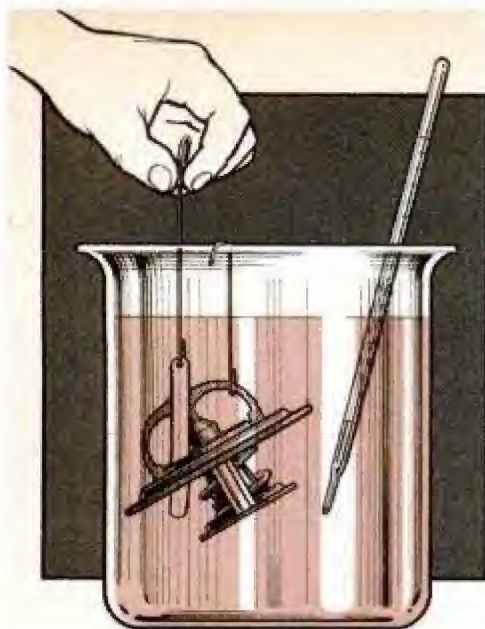
If the needle doesn't fluctuate, race the engine and watch the tailpipe. If a heavy amount of white smoke (steam) is expelled, it may indicate an internal coolant leak because of a cracked engine block or a cracked cylinder head.

One way of verifying an internal leak is to examine the oil dipstick. If water globules are mixed in with the oil, there's an internal leak.

Tips on thermostats

Most thermostats contain a wax pellet that expands when heated and contracts when cooled. The pellet is connected to a piston that operates a valve.

When the pellet heats and expands, it forces the valve open. As the pellet cools down and contracts, pressure is released, and a spring allows the valve to close. In other words, with a cold engine the thermostat valve remains closed. This keeps coolant out of the radiator and forces it to circulate



To test a thermostat, place it and a thermometer in water under heat. Check temperature when thermostat opens.

through the engine, so that it warms up quickly.

As the engine gets hot, the pellet expands, the thermostat valve opens and coolant is allowed to flow into the radiator, so cooling can take place before coolant starts to boil.

There are, therefore, two ways of recognizing that a thermostat has become defective:

1. The engine overheats. The thermostat valve may become stuck in the closed position, thus preventing the coolant from working its way into the radiator.
2. The engine warms up slowly, with the result that little or no heat comes from the heater. The thermostat valve is stuck in the open position.

Gauges better than lights

Owners of cars equipped with temperature gauges can determine if one of these problems is developing much better than car owners having only temperature warning lights. With a gauge, you can see if temperature is staying below normal. Not so with a light, which will turn off the instant when you start the engine and goes on again only if the engine overheats—if it's working as it should.

Furthermore, a thermostat that's causing overheating often begins to stick gradually; that is, over a period of time. As the situation gets worse, the engine will run hotter and hotter. This you can readily determine with a temperature gauge, but a warning light goes on only when the problem reaches a critical point—too late to be of help.

Replacing a thermostat

Admittedly, removing the thermostat every year for testing is a real pain. You have to drain the coolant; then unbolt and remove the thermostat housing—

which will destroy the gasket—in order to get at the thermostat.

You have to hang the thermostat on a pan filled with water, so that it's fully immersed; then heat the water as you keep one eye on the thermostat valve and the other eye on a thermometer. When the thermometer records the temperature stamped on the thermostat body, the valve should be wide open. If not, you have to replace the part.

Then, to reinstall the old thermostat or install a new one (make sure it's rated at the temperature specified by the car manufacturer), you have to clean the housing surfaces and install a new gasket.

An easier test

Here's an easier way to test the thermostat. General Motors advocates the use of temperature sticks. These are pencil-like devices which contain wax materials that will melt at specific temperatures. The temperature rating is specified on each stick.

You'll need two temperature sticks, or crayons, to test the thermostat—one that's rated at approximately 25° below

Crayons sensitive to temperature can check a thermostat without the need to remove it from the engine. Such crayons can be had from many laboratory supply houses. See text for instruction in how to use them.



the rating of the thermostat in your car and the other rated at about 10° above your thermostat.

If the thermostat in your car is rated at 195° F., you should use crayons rated at 169° F. and 206° F. These crayons are available from Omega Engineering, 1 Omega Drive, Stamford, Conn. 06907. They cost \$5 each.

When the engine is cold, remove the radiator-pressure cap. Clean the thermostat housing and rub wax from each stick onto the housing.

Start the engine and run it at a fast idle. As the "low-temperature" mark (169° F., for example) starts melting, look in the radiator (not the overflow tank). You should *not* see coolant moving (flowing). If coolant is flowing, it's a sign that the thermostat valve is probably stuck open.

Now, before the "high-temperature" mark (206° F.) starts melting, you should see coolant flowing. If you don't, the thermostat valve is probably stuck closed.

Fanfare

Your car has either a direct-drive, clutch-type or electric fan. Direct-drive and clutch-type fans are driven by belts, and bad belts are the most common cause of fans not working. If the fan isn't working, air can't circulate through the radiator to carry heat away, and overheating results.

So, to avert trouble because of a direct-drive or clutch-type fan that suddenly poops out because of a bad belt, inspect the belt for cracks, grease, frayed edges, or any other damage. Also, make certain that the belt is tight.

With the engine off and cold, look for bent and cracked fan blades. Replace the fan if blades are damaged.

If you have a clutch-type fan, turn the fan.

It should rotate freely, but you should feel slight resistance. Also, check the area for a fluid (silicone) leak from the clutch. If the fan is hard to turn or there is a leak, replace the fan.

As for an electric fan, there is no test to determine if the switch and motor are about to fail. However, it is possible to test the heat-sensitive actuating

switch which turns the fan motor on and off. These thermostatic switches are usually bolted into the engine block or cylinder head and their sensing ends are in direct contact with coolant. When the engine coolant reaches a specified temperature, the switch opens or closes a circuit and switches on the fan. A workshop manual will tell you at what temperature this should happen.

You test this switch in the same way you would check a conventional wax-pellet thermostat, but you must also make a circuit using a 12-volt power source and a test light in addition to a thermometer.

Immerse the sensor and the attached wires into a pan of heating water and keep an eye on the thermometer and test light. When the switch reaches its design temperature, the light should go on.

We'll have more tips on the all-important cooling system in Part 2 in our June issue. **PM**



FRESH AIR BREAKTHROUGH!

AMERICA'S NEWEST AND MOST POWERFUL BIPOLAR IONIZING-PRECIPITATOR CLEANS YOUR AIR OF HARMFUL, IRRITATING POLLUTANTS BETTER THAN ANY OTHER ROOM IONIZER.

IF YOU WANT CLEAN FRESH AIR OR YOU'VE UNPLUGGED YOUR POPULAR FILTER-FAN UNIT BECAUSE IT DOESN'T WORK THEN READ THIS...

Is your indoor air fresh, clean and alive? Indoor air pollution is becoming a national health hazard. Energy efficient airtight buildings are stifled with stale polluted air which contains tobacco smoke, smoke and soot from fireplaces, heating systems and cooking appliances, as well as dust, pollen, viruses, and bacteria. Most of these pollutants are so small (under 5 microns) that they are not effectively removed by common small filter-fan units. Scientific tests show that these noisy toy-like devices which emit chemical "citrus" odors are no match for high-powered ionizers in thoroughly cleaning indoor air.

ANOTHER IMPORTANT DIFFERENCE

You know how fresh and vibrant the air feels right after a rainstorm, in the mountains, or near a waterfall. That clean, alive fresh air is rich in something important that is greatly depleted in our urban and indoor air. That missing element is negative ions, nature's own air cleaners. Many users experience great benefit from these amazing active ions, including feelings of aliveness, alertness and vitality similar to that experienced in the fresh mountain air. In addition, even hospitals use ionizers in some units.

Filter fan units do not emit negative ions. The COLLECTOR, by Zestron, creates trillions of these beneficial ions every second, while giving you the best performance, value and technology in air cleaning.

THE ZESTRON BREAKTHROUGH!

Most ionizers clean your air but leave an untidy deposit of pollutants on room and furniture surfaces near the ionizer. The COLLECTOR by Zestron takes ion technology a giant step forward by giving you super-powered ion output while depositing pollutants from your air on the collector panel. This easy to clean panel features a scientifically formulated surface that electrostatically attracts the vast majority of airborne pollutants to it rather than to the floor or walls near the ionizer. Other bipolar ionizers with porous collecting surfaces that absorb odors and unsightly grime are almost impossible to clean.

AMAZING DEMONSTRATION!

Unplug your COLLECTOR, place the ionizer unit and an ash tray on top of the panel. Place a lit cigarette in the ash tray and watch the smoke rise into the air. Now plug it in, and amaze yourself and friends as the smoke barely rises above the ash tray and then nose-dives onto the collector panel before it can enter the room air. This is accomplished entirely electronically with no moving parts! The COLLECTOR by Zestron is the only ionizer on the market that cleans the air powerfully enough to accomplish this test.

ADJUSTABLE OUTPUT

Some people prefer fewer ions at night. The COLLECTOR is the only adjustable bipolar ionizer that allows you to set the ion level to your personal preference.

THOUSANDS OF SATISFIED USERS

Don't you, your family and friends deserve the healthy clean fresh air that Zestron ionizers have brought to thousands of satisfied users? Users write: "I simply can not believe how much better I feel!" Dr. E.K., DDS—MA; "I smoke heavily and it has cleared the air as advertised" G.P.—WA; "I haven't taken the top off my nasal decongestant spray since using your product. I was previously a chronic user." G.S.—SD.

When you use your COLLECTOR, you'll quickly feel the difference it makes and smell the freshness in your air. You'll actually see the elimination of smoke and dust in your air!

SILICON VALLEY TECHNOLOGY

The COLLECTOR, incorporating years of high reliability design experience, is built with quality parts in the heart of Silicon Valley, USA, to give you years of trouble free service.

The COLLECTOR operates anywhere in your home or office for pennies a month and has nothing to wear-out or replace.

SUPERPOWER OUTPUT

The COLLECTOR by Zestron is the only bipolar collecting ionizer with superpower output. The thoroughness and speed of air cleaning increases with more ion output, and Zestron ionizers give you the highest output (without detectable ozone). Check the comparison chart below. Note that many of the other ionizers on the market do not come equipped with a COLLECTOR or do not state ion output as measured in the industry standard of ions/cc/sec. at one meter.

IONIZER	ADVERTISED OUTPUT (1 m.) ions/cc/sec.	COLLECTOR
The COLLECTOR by Zestron	1,200,000	YES
JSA Bubble	not stated	YES
Orbit	not stated	YES
AirCarell	236,000	YES
Ion Fountain	540,000	NO
Ion Cloud	350,000	NO
Ionosphere	350,000	NO
Modulian	75,000	NO
Ion Breeze	not stated	NO

FREE ION DETECTOR

A FREE remote ion detector comes with each ZESTRON to verify and compare output. When you place the detector next to a ZESTRON and a competitive unit, you will see greatly reduced or no output from the competitive unit!

SATISFACTION GUARANTEED

Order a COLLECTOR now and try it in your home or office risk free for 30 days. If for any reason you are not satisfied, return the unit for a full refund including return postage. The COLLECTOR has a full one year warranty on both parts and labor excluding abuse.

ADDITIONAL DEALERSHIPS AVAILABLE

Reorders are pouring in, customers write: "We are enjoying the results of the first one and are ordering two more" Dr. J.B., M.C.—CA; "I'm a distributor for three other ion companies, and have to say I am extremely, extremely impressed." T.N.—CA.

ZESTRON, the leader in ion technology, has created a unique DEALERSHIP PROGRAM. Call or write for details on this RISK FREE OPPORTUNITY.

TO ORDER—FREE SHIPPING

Send your check or money order for \$119.95 for one or \$104.95 each for 2 or more (Calif. res. add 6.5% tax) or credit card users may call:

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or (408) 371-1200

ZESTRON, INC. Dept. M4
667 McGlincey Lane
Campbell, CA 95008

THE PM WORKBENCH



Coal miner's offspring?

When I spotted this little light at the National Hardware Show last year, my first reaction was that it was a gimmick. The maker challenged me to try one and I did. I have since (gratefully) used it on my head when working in a dark cellar to cut holes through flooring and sill for a plumbing installation, when working on a ladder and for other tasks for which a good light that didn't have to be held was welcome. Now my son has glommed it for exploring caves on his backpacking trips to the mountains.

The little Handi-Brite is a dandy light. It sells for \$10.95 postpaid, and you can wear it on your head or simply hold it. The light panel tilts, which is great when you wear it coal-miner style. If you do your own home carpentry, you should add this light to your toolbox. To order, write: Handi-Brite Inc., Box 1735, Haines City, Fla. 33844.—H.W.



Headband that comes with Handi-Brite is removable when you want to store it.



Light panel tilts up or down for job at hand. Housed in plastic, lamp is powered by two standard-size C batteries.

How to sand a crevice

A line of round abrasive cords and flat tapes sold by E.C. Mitchell Co. Inc., Box 607, Middleton, Mass. 01949, will let you sand smooth otherwise inaccessible spots. The cords come in diameters from .150 to .012 in., tapes in widths



Round abrasive cords quickly smooth areas like the fine grooves in spindles.



Author found flat tape indispensable on tight deburring jobs and when stripping old finishes from furniture.

Eliminate tangled cords

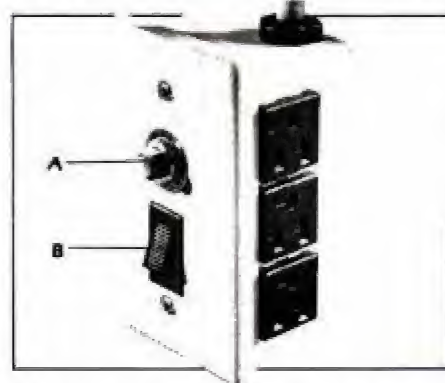


Cord Keeper stores 100 ft. of electric cord, which can be wound in or out with relative ease—an asset in the shop.

Chopper Industries, Box 87, Easton, Pa. 18042—the folks who gave us the Chopper 1 log-splitting ax—have unveiled another good one. It's the Chopper Cord Keeper which can be used to store electrical extension cord, rope, flat hose, chain or anything else that you can logically think of winding into the unit. I now have one in my shop—filled with electrical extension line—and it works like a charm. It is well-constructed and I simply hang it on a dowel when not needed. It's available in many home centers or by mail from the manufacturer for \$12.95 postpaid.—H.W.

Power to the workshop

Most multioutlet strips require you to clear valuable tool storage space on shop walls for installation. For that reason, I decided to give Snapit's multioutlet power center (Cat. No. 48725-6) a try. I can connect a half-dozen portable power tools to it without worrying about an overload. The unit has a 15-amp. reset breaker built right into the box. About \$24 at home centers, it's from Cable Electric Products, Box 6767, Providence, R.I. 02940.—H.W.



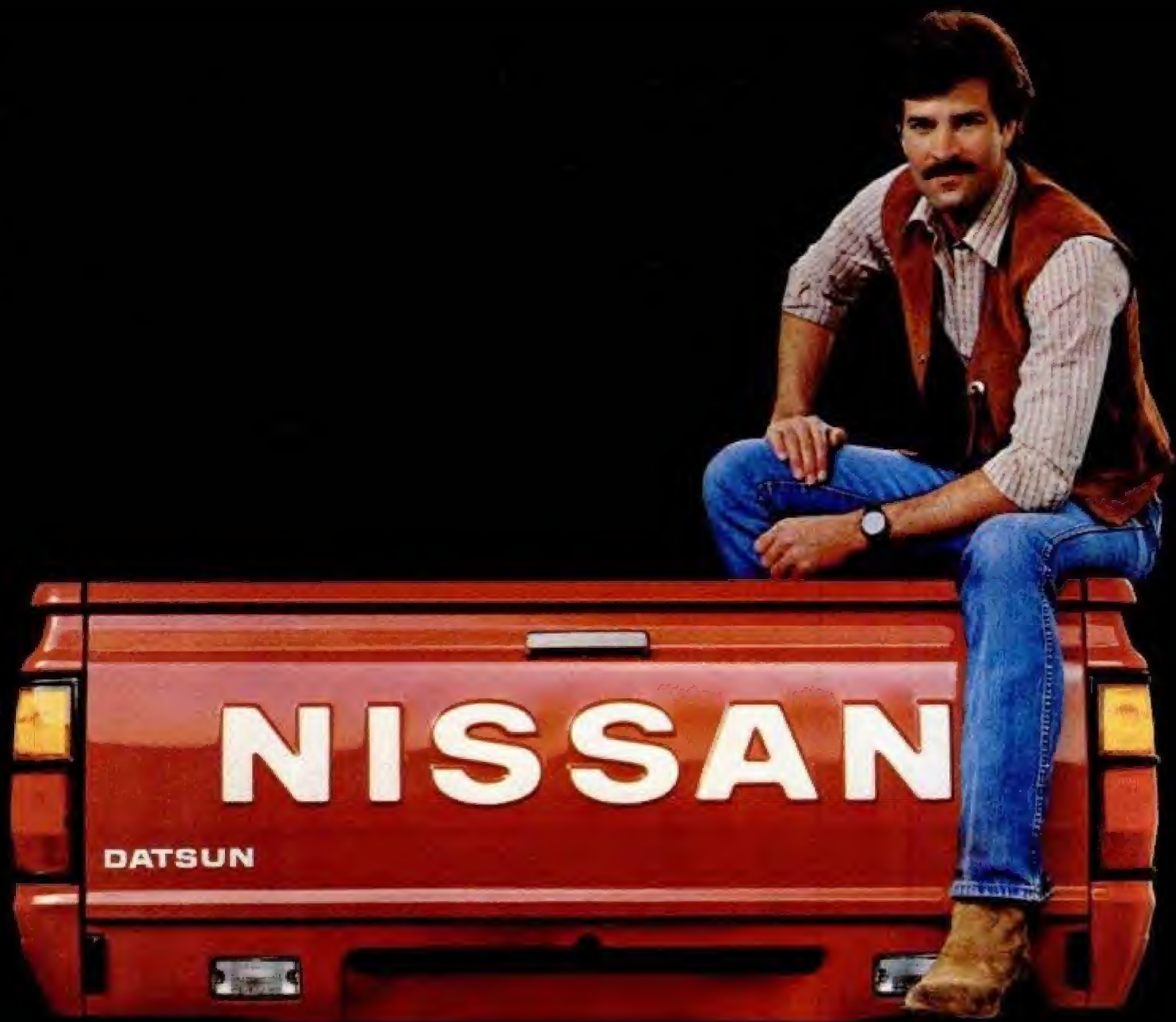
Multioutlet extension cord has 6 ft. of 14/3 wire (grounded), reset breaker (A) and switch (B) that glows if power is on.



Tapes and cords are available in a number of different sizes. Free sample cards are available from the manufacturer.

from $\frac{1}{16}$ to $\frac{1}{4}$ in. Cords and tapes are available in aluminum oxide, crocus and silicon carbide. Oil cords are also a stock item. A 75-ft. spool is about \$5. Write the maker for more information and a free sample card.—H.W.

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.



**ONE
HECK-OF-A-HUNK-
OF-A TRUCK!**
NOW AT YOUR DATSUN DEALER.

NEW NISSAN TRUCKS.

Here they come. A whole new line of trucks wearing a whole new name: Nissan.

Check 'em out. You'll find the most powerful standard engine in its class. You'll find new roominess to seat two, three or four.

You'll find double-wall bed construction and brawny 5-speed overdrives.

You'll find why more truckers drive Nissan-built compact pickups than any other.

And you'll agree: the newest Nissan is one heck-of-a-hunk-of-a truck.

ONE HUNK-OF-AN ENGINE.

The most power of any standard engine in its class.



More than Toyota, Chevy S-10, Ford Ranger and everyone else.

- Most horsepower: 103 hp @ 4800 RPM.
- Most torque: 133 ft.-lbs. @ 2800 RPM.
- Exclusive NAPS-Z overhead-cam

engine is so revolutionary, it's protected by more than 250 patents.

- Two sparkplugs per cylinder, crossflow hemihead and unique "fast-burn" design give maximum operating efficiency, minimum pollution.
- Electric fuel pump for reliable operation in extreme heat.

The most power of any standard 4-cylinder diesel:

Nobody else has a 2.5-liter diesel this brawny.

- Most horsepower: 70 hp @ 4000 RPM.
- Most torque: 114 ft.-lbs. @ 2000 RPM.
- All-new technology for rugged durability and superior performance, built on Nissan's almost two decades of diesel experience gained powering big trucks all over the world.
- Filter removes water from diesel fuel; electronic sensor tells you when to drain.

*Normally aspirated. Available soon.



(Clockwise from upper right):
Nissan Long Bed, Nissan
Standard, Nissan King Cab 4 X 4,
Nissan King Cab 2WD.

Nissan
ST Sport Truck

ONE HUNK-OF-A BODY.

Double-wall construction

- Double steel walls (except in MPG standard) prevent damage to cargo box's exterior sheet metal from shifting cargo. Not in Toyota.
- Heavy-Duty Long Bed hauls a remarkable 1,990-lb. payload of cargo and passengers. Not Toyota, Chevy S-10, Ford Ranger.
- Bigger payload than many full-size pickups.
- Bigger beds: longer King Cab bed than Chevy S-10; longer and wider Long Bed than Ford Ranger.
- Bigger King Cab payload than Chevy S-10 4 X 4.
- Welded steel ladder-lattice chassis—like the big rigs.
- Tailgate lowers 90°; 180° or removes entirely to carry your load.
- Double rear-wheel Cab & Chassis model: the only compact pickup with factory-installed duals for better stability and handling under load.



Cut-away view

ONE HECK-OF-A CAB.

Seat 3 in a conventional cab, 4 in the King Cab.®

- New cab seats 3 abreast (except 4 X 4 conventional cab and ST) in new comfort.
- More hiproom than Chevy S-10 or Toyota.
- More legroom than Ford Ranger, Chevy S-10 or Toyota.
- More headroom, legroom, seatback rake adjustment than in any Nissan-built standard compact ever.
- The original King Cab: up to nine cubic feet of extra inner space for safe storage and jump seats.
- Flip-out side windows standard in King Cab. Not in Chevy S-10.
- Sliding rear window available. (Standard on Sport and XE models.)



The Sport Truck that lives up to its name.

- Unique grille and bumper designs for contemporary styling: sleek in 2WD, rugged-looking in 4WD.
- Bucket seats designed like a sports car's with lateral support for extra comfort, control.
- Cloth upholstery on seats and doors; special trim on dash.
- Full instrumentation, laid out for maximum visibility.
- AM/FM multiplex stereo... standard.
- Day/night antiglare mirror on all Deluxe and XE models... and more.



ONE HECK-OF-A-HUNK- OF-A 4x4.

On-demand 4-wheel drive.

- Shift from 2WD to 4WD High at the flick of a stick—without stopping to lock front hubs. Not in Toyota.
- Highest minimum ground clearance of any compact. Higher than Toyota, Chevy S-10, Ford Ranger.
- New wide-clearance torsion-bar independent front suspension for a smooth, level ride. Unlike any other compact truck before.
- Tightest turning circle for maneuvering in tight spots. Runs rings inside Chevy S-10, Ford Ranger, Toyota.
- Front stabilizer bar; wide rear track for a solid stance.
- Wide radial tires standard: P215/75R X 15.



Everything you could want in a compact truck.

- Automatic transmission with lock-up torque converter for extra efficiency.
- Power steering with tilt column for extra thigh room.
- Sun roof standard on ST and optional on XE.
- Step bumper. And lots more available options.

SPECIFICATIONS-4 WD King Cab		EQUIPMENT	
Wheelbase (in.)	110.8	Brakes	power-assist front disc/ rear drum
Length (in.)	187.0	Wheels & tires	5.5K 15, GR78 15
Width (in.)	66.3	Front suspension	steel-belted RWL radial
Height (in.)	67.1	Rear suspension	independent adjustable torsion bars
Min. ground clearance (in.)	8.7	Radio	self-leveling leaf springs
Max. GVWR	4550	Selected options	2-speaker stereo air conditioning
Payload (lbs.)	1400		light bar, winch; grille guard
Fuel capacity (gal.)	15.9		
Bed length (in.)	73.4		
Bed width (in.)	56.9		
Bed depth (in.)	15.6		

†MSRP, sug. retail price excluding title, tax, license and destination charges.
*Not avail. in Calif. and high-altitude areas.

Nissan 4WD
King Cab

ONE HECK-OF-A SAVER.

Only \$5,995[†] for the Nissan MPG Standard.[†]
Big value, little money.

Economy is a tradition at Nissan, and has been for 50 years. That heritage continues this year with quality, advanced technology and standard equipment like radial tires (most models) for reduced rolling friction.

Every Nissan truck gives you solid value for your money, with extra features at no extra cost. Prices start at just \$5,995.[†] That's less than Toyota, Ford or Chevy, but look what you get:

- 5-speed overdrive transmission.
- Power front ventilated-disc brakes.
- Transistorized ignition for strong starts, low maintenance.
- Maintenance-free battery.
- Brake load-sensing valve.
- Flow-thru ventilation with side-window defoggers; bi-level heater.

Nissan is one heck-of-a-hunk-of-a truck, now at your Datsun Dealer.

NISSAN
WE ARE DRIVEN
DATSUN



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THE PM GARAGE



Superfast fire extinguisher

Halon gas fire extinguishers work so fast you'll hardly believe your eyes. When two Halon gas compounds act together inside the unit, one reacts as the propellant and one as the extinguisher. The extinguishing agent leaves no residue, so there's no cleanup after use. Because it works so fast, much less extinguishing agent is necessary to put out a given fire. The units are perpetually charged until completely exhausted of Halon gases. The Model 2500 has 15 seconds discharge capacity, but most fires are extinguished in fractions of a second with this unit. ASP makes four models. The 1000 is a tiny car unit. Model 2500 contains 1.2 pounds of Halon. The larger 3000 (2.2 pounds) and 4000 (3 pounds) models are for home use. When you figure the amount of use of a given unit compared



Halon-filled fire extinguishers don't need to be recharged after each use; they're disposable.

to a conventional extinguisher (which must be recharged after each use) the ASP units are competitively priced.

Available postpaid from ASP Northeast, RR4, Box 61, South Salem, N.Y. 10590. Prices are \$29.95 (for the 1000), \$49.95 (2500), \$69.96 (3000) or \$89.95 (4000).—J.O.

Hand cleaner

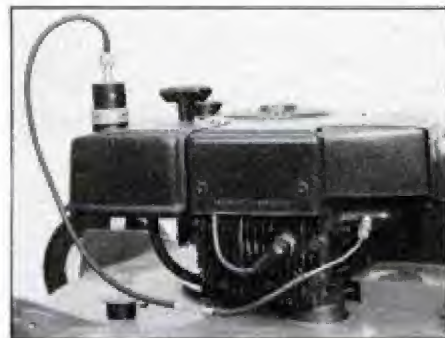


Hand cleaner has no ammonia or petroleum distillates and is biodegradable.

Tarkhelp, a new hand soap, does its job without leaving any smelly residue. The product is a mixture of wood flour and smooth round pumice suspended in a soap base. Tarkhelp also contains pine tar, kelp and lanolin to help condition your hands, and doesn't contain petroleum distillates or ammonia that can give your hands a bad smell. A 6-pound container costs about \$8.50 and the small size is under a buck. Tarkhelp Mfg. Corp. is at Box 605, Kirkland, Wash. 98033.—Joel Breault

Mower injection

Pull-starting a small four-stroke can leave you panting, but this fuel-injection system fires up first shot. You replace the gas cap with a plunger to which a fuel line is attached. The line connects to a fuel injector you install on the intake manifold. You have to drill a hole and tap it for the nozzle. The tap comes with the kit. When you're ready to start, give the plunger a squirt and pull the cord. It worked great on our portable generator.



Fuel-injection system for small four-stroke motors fires them up first try.

The price is \$19.95 plus \$1.50 for shipping from JLM Products & Design, 6805 Boysenberry Way, Colorado Springs, Colo. 90818—T.A.

Stick-on antenna

Using a new type of foam tape adhesive, the base of this CB antenna may be mounted directly to the vehicle's rear glass or windshield and it needs no wire hookup. There are no holes to drill or special tools needed. The antenna signal is picked up through the glass by a sensor.



Adhesive-backed antenna sticks on outside of glass; pickup mounts inside.

The Avanti may be mounted to any nonconductive surface less than 3/4-inch thick so it can be used on cars, boats or motorhomes.

It's approximately \$40 at CB/Stereo outlets, or, write directly to the Antenna Specialists at 12435 Euclid Ave., Cleveland, Ohio 44106.

—Joel Breault

HOMEOWNERS' CLINIC



Antifreeze in hot-water system

I have a 20-year-old, cast-iron boiler hot-water heating system with copper tubing. Could I use an antifreeze solution when we're away in the winter to prevent the system from freezing?—Name Withheld, New Hartford, N.Y.

You can add antifreeze (glycol) to the closed hot-water system. However, this is one job that is best left to professionals for the following reasons:

1. The hot-water system must be drained.
2. About 50 percent of the system should be filled with antifreeze.
3. It's difficult to determine the necessary amount of antifreeze to add to the system.

You can purchase glycol at plumbing supply houses. However, you will still have to deal with the domestic water.

Foam insulation

My insulation installer recommended urethane foam in my attic. He claims that 1 in. of urethane will equate to an R-30 value. I have heard that plastic foams should be avoided. Also, how can 1 in. of urethane equal an R-30 value, when 6 in. of fiberglass can't get anywhere near that?—Fred Weitzel, Pine Apple, Ala.

Foam in your attic? Never. Foam was developed for use in walls, or on flat roofs (mainly commercial ones). Seriously consider changing installers, as a check with the Insulation Contractors Assn. of America, Washington, D.C., revealed the following R-values for 1 in. of various foam-type insulations: (Although they are usually sold as a board product, they are sometimes sprayed or poured in place.)

Polystyrene R-5

Polyurethane R-6.2

Polyisocyanurate R-7.2

The above R-values are for average density material.

Do not confuse all "foam" insulations with urea-formaldehyde, which the Consumer Product Safety Commission has deemed harmful to your health. As most foams are flammable, certain precautions should be taken. (See "I Stand Corrected," *Homeowners' Clinic*, page 59, Sept. '82.)

Peeling paint on church

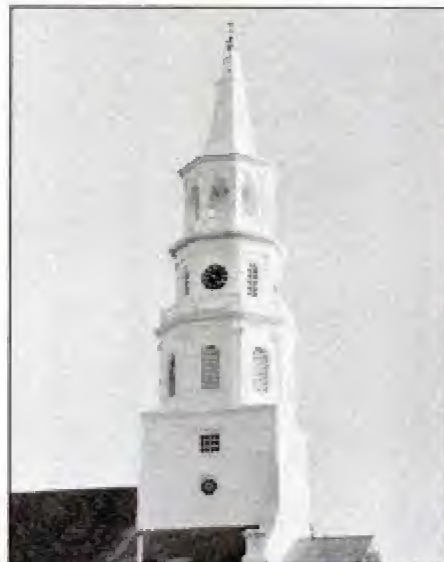
The paint on the tower of my church is peeling. Any advice before we start repainting?—Monsignor Brennan, St. Peter's Church, Kingston, N.Y.

I observed beautiful St. Michael's church and steeple in Charleston, S.C., being repainted. This harbor city is

subject to both heat and high humidity, conditions that are tough on paint jobs. Paint contractor Leonard Fulghum of Ferguson Fulghum Inc. brought out some interesting points:

Ventilation is important for any painted surface, as moisture behind the paint will peel the paint off as the moisture tries to escape (see "Mildew and Peeling Paint," *Homeowners' Clinic*, page 52, Oct. '80; also see our paint story in the Home Ideas Guide, page 115). This will be the case even more so in a steeple, which is exposed to the elements at all times. Tell your contractor to check for adequate ventilation prior to starting the painting.

Leonard prefers an oil-base paint, as its glossy surface helps repel mildew. (X-14 or M-1 paint additives can also help fight mildew.)



Adequate ventilation helps the paint on St. Michael's steeple endure the weather.

If your steeple is metal and you can't sandblast, the old paint must be removed mechanically, prior to applying a good grade of primer. Leonard cautions, "Don't stint on the primer and paint." If your painting contractor isn't certain what precautions to take, consult the manufacturer.

Mildew and more mildew

My 6-year-old house with textured siding was painted with Glidden latex stain. It has good drainage and gets very little shade. However, within a very short time mildew started to appear under the eaves and gradually covered the trim and siding. Two years ago we washed the mildew off with a brush and solution of bleach, tri-sodium phosphate and water. Then we rinsed well and sprayed on full-strength bleach. After the bleach dried, we sprayed the house with two coats of Glidden oil-base stain. Within six months the mildew reappeared. It's worse than ever. What do you suggest?—Stephen Ensminger, Auburn, Ala.

Sure Cote, by Jomaps Inc., Box 88583, Atlanta, Ga. 30356-8583, is a liquid that is applied to any surface to resist mildew for a long period of time. Following the manufacturer's directions, you may even use it on book covers, wallpaper, drapes and ceramic tile. It's used for both interior and exterior applications.

My front door had recurring mildew, just as you've had with your house. After I removed the mildew the second time I used Sure Cote. The door hasn't had mildew since.

Available in pint and gallon sizes, the manufacturer's suggested price is \$12.50 per gallon. Coverage is about 400-450 sq. ft. per gallon depending on the surface. It can be sprayed, brushed or rolled on. The company recommends a reapplication of the clear acrylic coating every year to keep a mildew-free surface. **PM**

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

WIN A POTHOLE FULL OF DOUGH FROM MONROE.[®]

The Bump Stops Here Sweepstakes.

Whoever thought those annoying, troublesome potholes could bring you \$10,000 in cash?

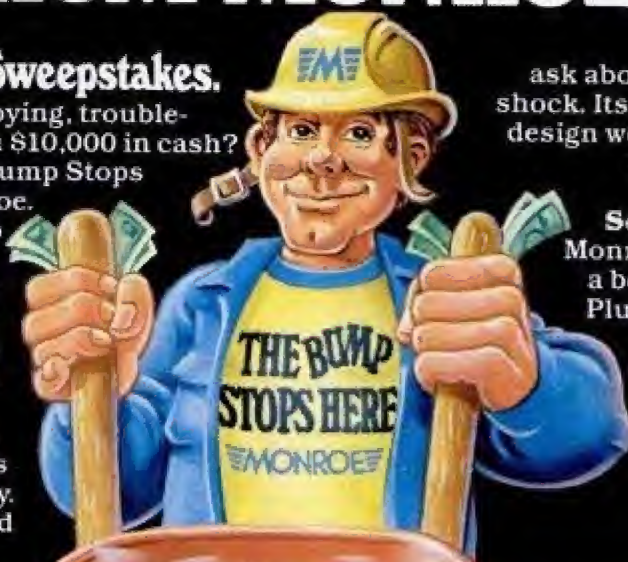
Well, they can during "The Bump Stops Here" Sweepstakes from Monroe.

It's easy to enter. And easy to win. Just stop at any participating Monroe retailer, fill out the entry form

and mail it in.* That's it. There's no obligation . . . nothing to buy.

You could then win the Grand Prize of \$10,000. Or one of the three second prizes of \$1,000.

And while you're at your Monroe retailer, ask him about his colorful Bump Stops Here T-shirts. They're a fun way to tell the world you've had it with America's roads. And don't forget to



ask about the Monroe Gas-Matic[™] shock. Its low-pressure gas charging design works like a cushion against bumps, tarstrips and other small car road hazards.

So stop at your participating Monroe retailer today. You'll get a better ride in your small car. Plus, a chance to win \$10,000.



*Small Car America
Rides Monroe.*

*Or, print your name and address on a plain piece of 3x5 paper. No mechanically reproduced entries accepted. Enter as often as you wish. Each entry must be mailed separately. Mail it to: Monroe "The Bump Stops Here" Sweepstakes, P.O. Box 7, NY, NY 10046. Entries must be postmarked by midnight, 7/31/83, and received by 8/12/83. You must be 16 years or older to enter.

THE BUMP STOPS HERE.

MONROE

Monroe Auto Equipment
Division of Tenneco Automotive



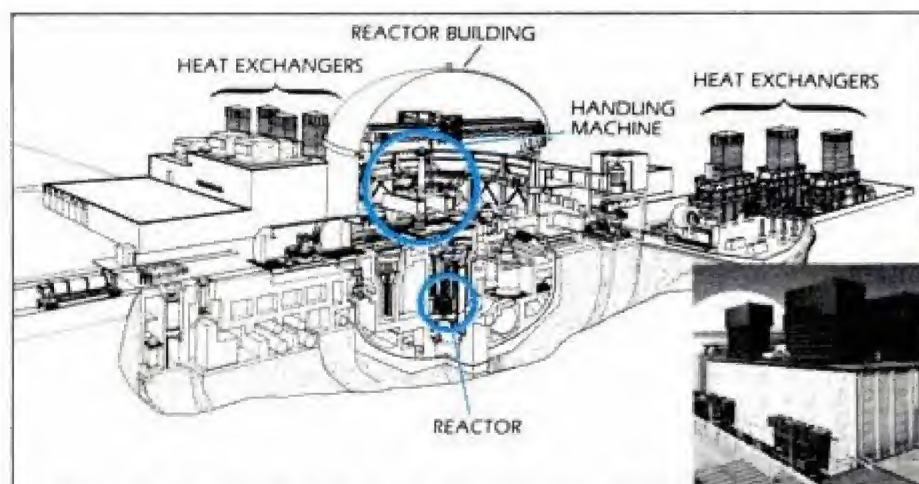
SCIENCE WORLDWIDE



Testing parts for breeders

America's slow and deliberate breeder-reactor program enters a major development stage this month with the start of a year-long experiment at Richland, Wash. That's where Westinghouse-Hanford operates the Fast Flux Test Reactor, a standard, fission-type atomic reactor outfitted for experiments leading to the breeder's devel-

lower a 40-foot-long tube into the depths of the cavernous Hanford reactor building with a four-story-high pulley, part of the handling machine. Inside the tube are hundreds of samples of alloys—all candidates for making parts to be used inside the Clinch River, Tenn., breeder-reactor now under construction. The alloys will be



Tests at Hanford will use a huge handling machine to lower potential parts for breeder-reactor construction into the heat and radiation of the facility's reactor.

opment. (A breeder uses radioactive material to produce energy plus additional radioactive material. Thus it produces more fuel than it consumes.)

The tests will begin when engineers

subjected to the reactor's 1,000°F. plus temperatures for weeks on end to see how they take the heat. Seven three-story heat exchangers will maintain livable temperatures in the building.

Let the chips fall

Microchips have revolutionized the computer industry, turning tiny bits of silicon into memories that drive an amazing array of electronics devices. But is there something better than silicon? Would you believe biochips?

Theoretically, a biochip would use chemicals found in the human body to form a computer chip as complex as a human brain cell. *Physics News*, while noting such chips are only on the drawing boards today, still says a major step was taken by British researchers last year that could lead to biochips. The researchers found that a molecule called Hemiquinone—found in human blood—can oscillate two atoms of hydrogen back and forth between two

segments of the molecule. That action creates binary off-on circuits. The next problem to solve: how to hook thousands of such molecules together to form an intelligent chip.

Follow that meteor!

Some reported sightings of meteorites have contained gross exaggerations, according to Florida meteor watcher Stephen L. Morgan. He says many such reports note the duration of the fireball in a casual manner. Some, he writes in *Meteor News*, are exaggerated by a factor of two or three. Morgan advises observers to be extremely conservative in estimating meteor duration, which is usually less than 3 seconds.

Fighting decadent art

Some of Europe's greatest historical and artistic treasures are falling apart with age. But a team of Austrian scientists reports a new technique that may save hundreds of such objects. Treating several ancient maps, manuscripts and paintings with a magnesium-carbonate compound, the scientists say they were able to arrest the decay of paper and cloth containing copper-base pigments. The Austrians say the compound forms a tight chemical bond between the pigments and the surfaces to which they were applied. Two years have gone by, but it will take more time to prove that the effect is lasting.

Rain, by thunder!

Thunder always comes in rainy weather, but the relationship between rain and thunder may be deeper than we've imagined. Rutgers University Aerospace Dept. head Samuel Temkin believes that thunder claps often cause rain. His research with large amplitude sound waves has included setting up a simulated thunder clap in a lab near tiny droplets of water. For one thing, he says, the sound wave from a thunder clap moves water droplets close together, making rainfall more likely. Temkin also notes that post-lightning shock waves tend to break up water droplets, sending them flying until they collide. The heavier droplets, he says, are what we call rain. Temkin cautions that his theories are based on laboratory work and field experiments will have to be conducted to prove them.

Send no flowers

Bees that eat something other than pollen have been discovered by a Smithsonian Tropical Research Institute team in eastern Panama. The bees, named *Trigona hypogaea* by David W. Roubik and his fellow researchers, eat carrion—the decaying flesh of dead animals.

Meat-eating bees may strike a chilling note for most of us, but Roubik reports the *T. hypogaea* has no stinger and searches for dead flesh only. The bees partially digest the meat, then take it back to the hive, regurgitating it to other bees.

PM

**More horsepower and torque
than Chevy S-10!**

Ford's Ranger is already the best-selling 4-cylinder pickup built in America. Now it offers V-6 power and performance, too! Ranger's new 2.8L V-6 is available in 4x2 and 4x4 models.

More payload than Chevy S-10. Ranger's 1755-lb. payload option is the largest of any American-built small pickup.

R. L. Polk & Co. CYTD registrations for 4x2 models through October, 1982.

Ford's new Electronic Engine Control, EEC-IV, constantly monitors the Ranger V-6 for most effective performance. It can process a million commands a second!



Widest choice of engines. Only Ranger 4x2

offers two 4-cylinder gas engines and a V-6, plus a new diesel that the Chevy S-10 can't match.

FORD

FORD DIVISION



FORD **V-6** RANGER. THE MOST POWERFUL V-6 IN ANY SMALL PICKUP!



Get it together—Buckle up.

AMERICA'S TRUCK

**TOUGH
FORD
RANGER**

Motorная, усиленная, внедорожная версия

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Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Kings, 9 mg. "tar", 0.8 mg. nicotine, 100's, 10 mg. "tar",
0.9 mg. nicotine av. per cigarette by FTC method.

KOOL LIGHTS

**There's only one
way to play it.**

There's only one
sensation this refreshing.
Low 'tar' Kool Lights.
The taste doesn't
miss a beat.



CAMPING '83



Pick cruising canoes for day travel and a family-sized tent, like White Stag/Henderson's new Gold Miner, for budget roughing-it.

Today, the outdoors is still the best of bargains for family vacations. A campground is a great base of action for sightseeing and biking, backpacking and boating, climbing, spelunking, water sports, photography, bird-and-wildlife watching, hunting, fishing, rock-hounding—choose one or all.

Here are new places to go, new tents to pitch when you get there and new gear and supplies to take along—plus where to write for more information on campgrounds and gear.

WHITE HEAT

2.6 GT
OUR BOLD, NEW
OUTBOARD
POWER LEADER



Introducing the world's hottest new production outboard: the 2.6 GT from Johnson. Designed for the bold breed of boating enthusiast who demands uncompromising performance, the 2.6 GT delivers more power than any production model we've ever offered. The awesome performance of this 2.6 litre outboard is the result of advanced technology, tested and refined in the heat of boat racing competition throughout the world.

There's a bit of race driver in all of us. If you're bold enough, the Johnson® 2.6 GT is hot enough.

**Another reason
Johnson leads the world.**



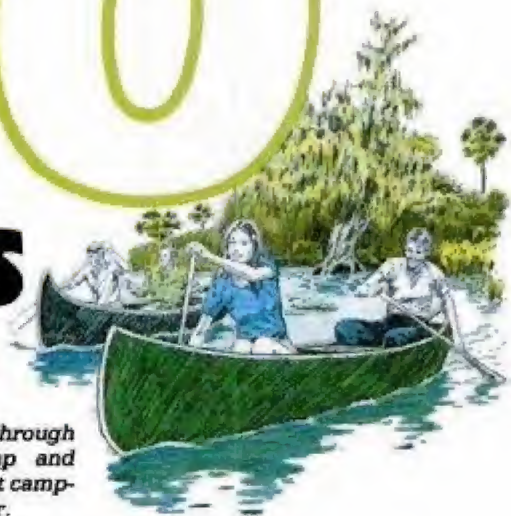
 **Johnson**

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Family Camping Adventures

10



Canoeing: Paddling trails through Georgia's Okefenokee Swamp and down many waterways connect camping sites to the Suwanee River.

Only in the great outdoors are there so many sights and activities for a 1983 vacation you won't forget.

BY RICHARD DUNLOP

This year, why not pitch your tent close to where the Vikings erected their long houses at L'Anse-aux-Meadows in Newfoundland? Or set up at Carlsbad Caverns National Park, New Mexico, and hike through the wild New Cave? You can camp and look for diamonds in Crater of Diamonds State Park, Arkansas, or go boat camping in Alaska's Glacier Bay National Park.

Camping combines with all sorts of family vacation possibilities. Go cycling, riding, hiking, backpacking, canoeing and sightseeing on your vacations and still spend your nights in your tent or RV. Here are 10 family camping suggestions.

North to the Viking past

You can wade into a stream that flows into the sea at L'Anse-aux-Meadows on the far northern tip of Newfoundland, and catch salmon with your bare hands. The Vikings did it there over 900 years ago, as archaeologists learned from the Norse sagas. When archaeologists dug into the mounds of what nearby fishermen had always thought were the remains of an Indian camp, they found the foundations of Viking long houses. Today, L'Anse-aux-

Meadows can be the goal for family camping adventure.

Drive through the Canadian Maritimes to North Sydney on Nova Scotia's Cape Breton Island, from where a sea-going ferry takes motorists across Cabot Strait to Port-aux-Basques in Newfoundland. From there it is only a short drive along Route 1, the TransCanada Highway, to the J.T. Cheesman Provincial Park where a family can set up its tent by the sea. The surf surges ashore, and the wind sighs through the pines.

The road to the Viking past allows campers to stop at such outstanding salmon streams as Flat Bay Brook, and camp at Barachois Pond. Rangers lead youngsters on nature hikes during the summer. Another night's camp might be made at Blue Ponds, where swimmers splash in fresh-water ponds fed by limestone-based springs.

It is at Deer Lake, a logging town that's surrounded by thick

forests, that Highway 430, the Viking Trail, leaves Highway 1 and strikes northwest into Gros Morne National Park. Dramatic fjords off Bonne Bay cut deep into massive mountains, and there are many campgrounds. The Viking Trail leads north along the west coast past striking dolomite arches set in the sea to Port au Choix. At this park, prehistoric Indian burial grounds were excavated in 1968. Dorset Eskimo sites are nearby. Northward along the coast, scores of fishing villages such as Deadman's Cove, St. Barbe and Blue Cove rival one another in beauty and friendliness. Then at the northern tip of Newfoundland there is L'Anse-aux-Meadows where the Norse settled 500 years before Columbus's voyage. Camp at nearby Pistolet Bay, where archaeologists first looked unsuccessfully for the lost Viking settlement, and



Exploring historic sights: About 500 years before Columbus, Viking sailors built a camp near the modern campsites now at the northern tip of Newfoundland.

CAMPING '83



Bartlett Cove,
Glacier Bay National
Park, Alaska



Spelunking: For under-this-world adventure, try exploring caves like Carlsbad. Many caves and grottos are found near campgrounds across the country.

drive over the dirt roads to L'Anse. Canada has erected replicas of Viking structures close to the original sites; for a family gazing out to sea from a Norse dwelling it almost seems as if the long boats of the Northmen might again be seen.

Spelunking at Carlsbad

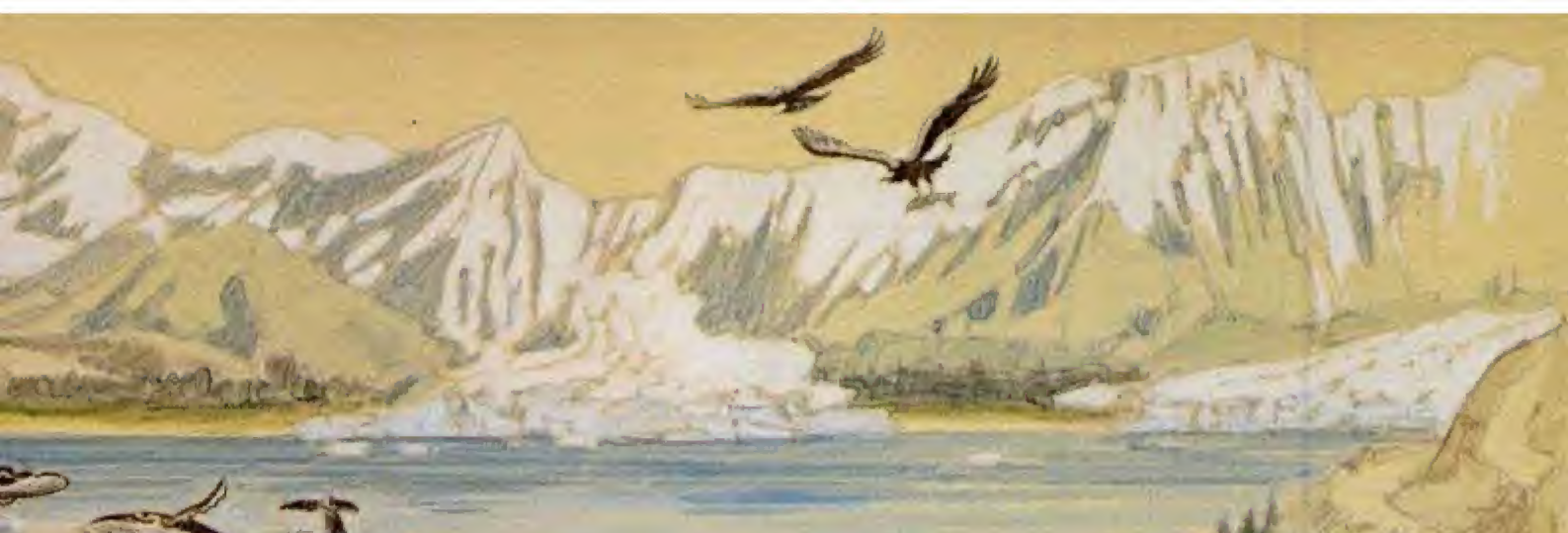
Rangers at Carlsbad Caverns National Park in New Mexico are tricky.

Carlsbad Caverns
National Park,
New Mexico

Big Bend National
Park, Texas



Trail riding: Along the Rio Grande's Big Bend in Texas, or across the prairies of any western state, vacationers get a close look at the open country surrounding campsites where the buffalo roamed.



Nature cruises: At Bartlett Cove, far-north vacationers can glide through ice floes to see wildlife that seems to be almost untouched by time and encroaching civilization.



Porcupine Mountains State Wilderness Park, Michigan

They tell spelunkers who want to explore the wild New Cave to meet them at the cave entrance. This means that family hikers must first climb for a mile up a steep trail that switchbacks up Slaughter Canyon.

"We know if a hiker can get up to the entrance of the cave, he can make it through the cave itself," says Ranger John McLaughlin.

Hikers zigzag down a slippery

Crater of Diamonds State Park, Arkansas

New Iberia, Louisiana

Gulford, Vermont



By bike: Take back roads from Guilford, Vt., and wind through New England's aging reminders of early colonial architecture.

Assateague National Seashore, Maryland



Shoreline sights: Wild ponies of the Eastern Shore descended from survivors of shipwrecks.

Okefenokee Swamp, Georgia



Gem collecting: Jewels reward amateur prospectors at Crater of Diamonds and other back-country campsites.

Old-home tours: Plantations survive in Louisiana bayou country.



slope at the entrance to the cave. They pass a pool that looks 3 feet deep in a flashlight's gleam but actually is over 30 feet deep. They slide down slopes of guano using a technique that would do credit to a crosscountry skier. They penetrate the domain of cave crickets and the spiders that dine on them. Narrow passages emerge into gigantic rooms. Reed torches on the floor were thrown down by cave-exploring Indians generations ago. As a climax, the rangers leave the hikers alone in the gloom to know what it really is like to be in the dark. After the spelunking, a family can camp in Carlsbad National Park.

Crater of Diamonds

Diamonds are a rockhound's best friend, as any camper in Crater of Diamonds State Park, Arkansas, will say. A Dallas woman scrounged about in the clay until she found what turned out to be a diamond worth \$75,000. The largest stone yet discovered in the 78-acre diamond-bearing volcanic pipe is the Uncle Sam, which weighed 40.23 carats. Kids usually find more diamonds than grown-ups. An electrician from Pine Bluff, Ark., and his family had no luck until his toddler daughter popped a stone in her mouth. Afraid that she might choke, he pried it out of her jaws. It turned out to be a diamond worth \$5,000. Sites with modern facilities are on the campground loop.

Boat camping in Glacier Bay

Sail from Bartlett Cove in Glacier Bay National Park, Alaska, aboard the *Glacier Bay Explorer*. The captain will put a camping family ashore with its gear at one of several wilderness areas and pick them up when desired. Other campers kayak to their sites. Every year 3,500 back-country campers try out the shores of the bay where killer whales sport and blow, and harbor seals rest on icebergs.

Backpacking: Through the Porcupine Mountains in Michigan and hundreds of other areas, family packers can get almost uncomfortably close to nature.

Backpacking in the Porkies

The Porcupine Mountains State Wilderness Park in Michigan's Upper Peninsula gives family backpackers a challenging escarpment to mount, also as streams and limpid lakes on whose shores tents can be set up. The fishing is excellent, and rock formations intriguing to study. Backpackers must take precautions against bears. At night it is necessary to hang provisions from tree branches.

Wild ponies of Assateague

No one—young or old—who visits the Assateague National Seashore in Maryland will ever forget his first sight of the wild ponies, their shaggy manes flying as they run free beside the sea. It is said their ancestors swam ashore from a foundering Spanish galleon. Campers on Maryland's Eastern Shore also visit such spots as Winter Place Farm near Salisbury, where thoroughbred jumpers and hunters are trained for the Olympics, and the Blackwater National Wildlife Refuge, the most important resting and feeding area for migrant and wintering waterfowl on the Atlantic Flyway.

Cajun lagniappe

Family campers in the Cajun country of Louisiana find the Creole word "lagniappe" applies. It means a little bit extra thrown in for good measure, and could apply to such fascinating places as Lauren Valley Plantation on Bayou Lafourche near Thibodaux, the largest collection of old outbuildings in the state. The weatherbeaten houses gather around the ruins of a sugar mill where their inhabitants worked until a hurricane blasted it in 1965. Lagniappe also includes Avery Island and its gardens, and St. Martinville, site of the oak where Evangeline, Longfellow's Acadian heroine, stepped ashore. Best is Shadows on the Teche, one of the

South's most beautiful mansions, at New Iberia. Private campgrounds are at Lafayette and New Iberia.

Okefenokee canoe trails

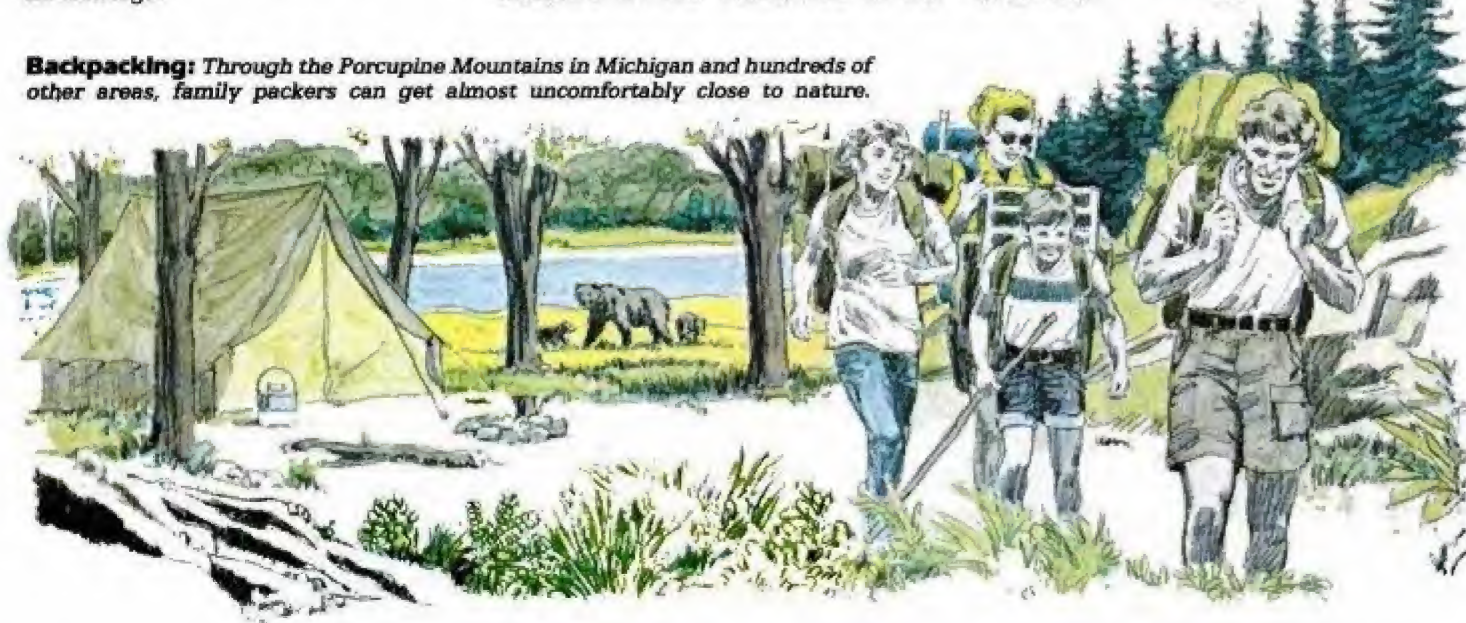
Paddlers enter Georgia's Okefenokee Swamp from the Folkston side, either at Kingfisher Landing, Duck Island or the Suwanee Canal. As one outfitter says, "There is no fast water and very little dry land. Your paddle will be used every inch of the way." This doesn't keep family canoe campers from threading this mysterious swamp to see alligators and other wildlife. At night they pitch tents on platforms over the wet ground. Some even obtain guides, cross to the far Florida side, and descend the Suwanee River.

Biking in Vermont

Close by the Massachusetts line, the Vermont Hostel Tour begins at Guilford, and winds its way over rugged hills and dales for 200 miles to Richford near the Canadian border. Bike campers stay in hostels or campgrounds. Details about the route may be obtained from the American Youth Hostels.

Trail riding the Big Bend

Western historian Walter Prescott Webb said "Big Bend fever is being homesick for a place you can never call home." Big Bend National Park, Texas, is much too rugged to make a home for most families, but is a spectacular place for riding and camping. Of a dozen trails, the one to Window is most popular. It winds down into a canyon between high cliffs where often a red hawk wheels overhead. A waterfall dashes out of a cleft in the mountain and tumbles hundreds of feet to the valley floor. Sitting around a campfire in the Chisos Mountains is camping at its best. **PM**





In a tough town like El Paso, we beat the big gun.

It was a classic duel out of the Old West. Except the gun-fighters were out of the Far East. There was Toyota. The big company with the big name. And there was Isuzu. The young company with the unusual name.

The setting, El Paso, Texas. A town with temperatures that would make a sun dial ask for salt tablets.

A town of over 500,000 people—and not one of them afraid to get dirt under their fingernails. In short, a town that doesn't cotton to city slickers.

It's not surprising then, to learn that in a town that still retains so much of the frontier spirit, a tough truck like Isuzu has managed to outsell Toyota** in only a very short period of time.

And the reasons are simple. The Isuzu long-bed's diesel's range of 840 miles* is the greatest

range of any truck in its category. And when you're riding the range of El Paso, this becomes very important.

What's more, Isuzu delivers the greatest mileage of any imported pick up in America—with an incredible 49 MPG highway—and an estimated [38] MPG in the city. And that's better than Toyota or Datsun.

Of course, while all of this should make you think the Isuzu is one tough truck, you should also know Isuzus do have a soft spot. The inside. Once you step inside the cab, you'll have more leg and head room than a mini-pick up is supposed to have. With a choice of three across seating or bucket seats.

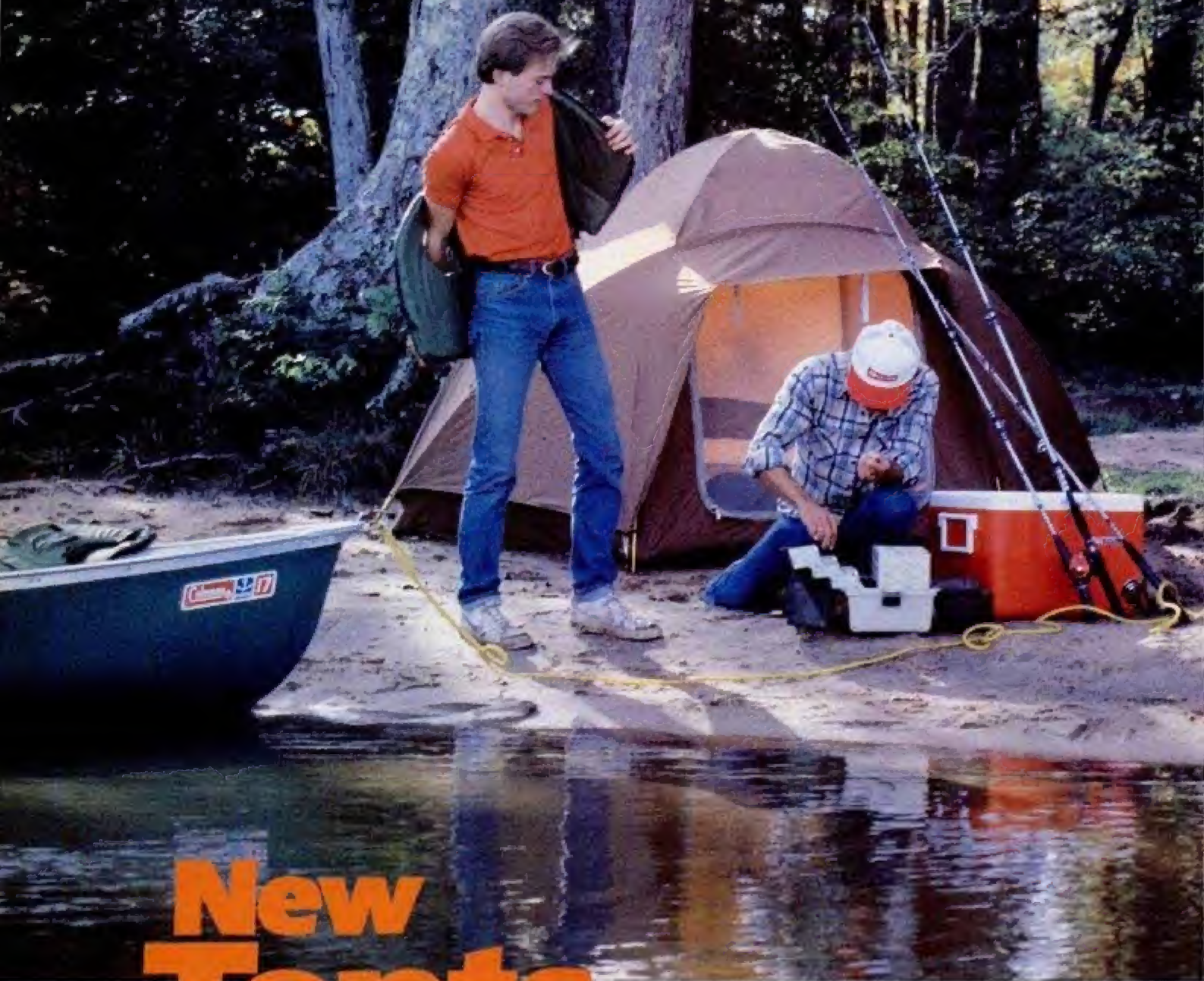
What it all comes down to, is after 67 years of proving how tough we are all over the world, Isuzu has just added a new chapter of how the West was won.



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**SALES FIGURES BASED ON R.S. POLA NEW VEHICLE REGISTRATIONS FOR THE PERIOD JANUARY 1987 THROUGH AUGUST 1987.


CAMPING
'83



New Tents For Better Shelters

They're lighter, stronger, easier to pitch,
and some are engineered to stand on their own.

Peak 1 A-Line, with wet-weather fly, uses shock cord to make framing easy.



Coleman's new Peak 1-Omega (left) is two tents in one. With outer shell (fly) installed, as shown here, tent is warm and rainproof. With fly removed, breezes can blow through porous inner tent for summer cooling. Wenzel's Sunsetter screen house (below) is suitable for back-yard or back-country family activities.



The Flagship (above) from Moss Tent Works in Camden, Me., is free-standing, roomy, sleeps four. Curvilinear cabin tent by Wenzel (left) has a 6-foot, 4-inch headroom and can sleep up to five campers.

The simple A-frame is still popular this spring, but many new tents look as if they were designed by a spider or intended as the dwelling of a caterpillar or a chambered nautilus.

"I'm always finding designs in nature which I have used in my tents," observes Charles William Moss, who has become the most important guru of tentmakers since Omar fashioned fabled fabric shelters in ancient Baghdad.

In 1955, Moss created the first umbrella tent, which soon replaced the pup tent. Its metal framework outside the fabric led to the current crop of membrane tents in which aluminum rods are inserted in the material. Moss, who was trained as an artist at the University of Michigan, designs tents with a painter's eye for form, but when his tents were subjected to computer analysis at the Massachusetts Institute of Technology, they were proven to be as aerodynamic as those created by engineers. His tents are also tough. In 1978 Moss set up an entire tent city in the deserts of Saudi Arabia to test his designs, and they were all blown away by the angry winds. This sent him back to the drawing board to create a group of tents that will stand up to Arabian winds and the frigid blasts outside his headquarters in Camden, Me., as well.

Moss's Optimum 200 and other big tents are constructed of cotton duck, but his backpacking tents employ nylon taffeta uppers and nylon Ripstop floors. They are supported by ribs of aircraft alloy aluminum tubing connected to the fabric by elastic cords. These tents are organic shaped, which is to say they are hyperbolic paraboloids, and the wind has a difficult time getting a firm hold on them.

The new tents manufacturers are showing this spring are as rugged as they are lightweight. They are easy to set up and take down, and they are well

ventilated. They favor the geodesic dome because it provides the most volume with the least surface area, and its supple framework bends with the wind. Campers who prefer the A-frame will still find it available among new tents, for few can deny it sheds the rain best even if it takes a buffeting by the wind. Tunnel-shaped tents, in reality a variant of the A-frame, are competing successfully with the geodesic models.

Among top tent manufacturers to offer an A-frame this spring is Johnson Camping. Speaking about the Eureka line, Johnson's Linda Snupik says, "The Alpine Meadows was developed as an extension of our classic A-frame design. While the front and rear maintain the A-shape, we add-

PM photo: Ben Magro

ed a center hoop which has increased shoulder and headroom and provides greater stability."

The importance of effective tent poles has never been more fully appreciated. James Thomsen, president of Wilderness Experience, one of the most highly regarded West Coast tentmakers, confesses that his company has found it necessary to strengthen the poles of its Sanctuary Tent, even at the cost of adding weight.

"Testing told us to be leery of fiberglass poles, so we switched to heavier yet stronger solid poles," he says. "When we made the ferrules sturdier, the total weight gained." On the other hand, Sierra West's Roger McDevitt says this spring's poles in all six of their tents will be of extruded aluminum or fiberglass, both being very light.

Fabric is the other major topic for



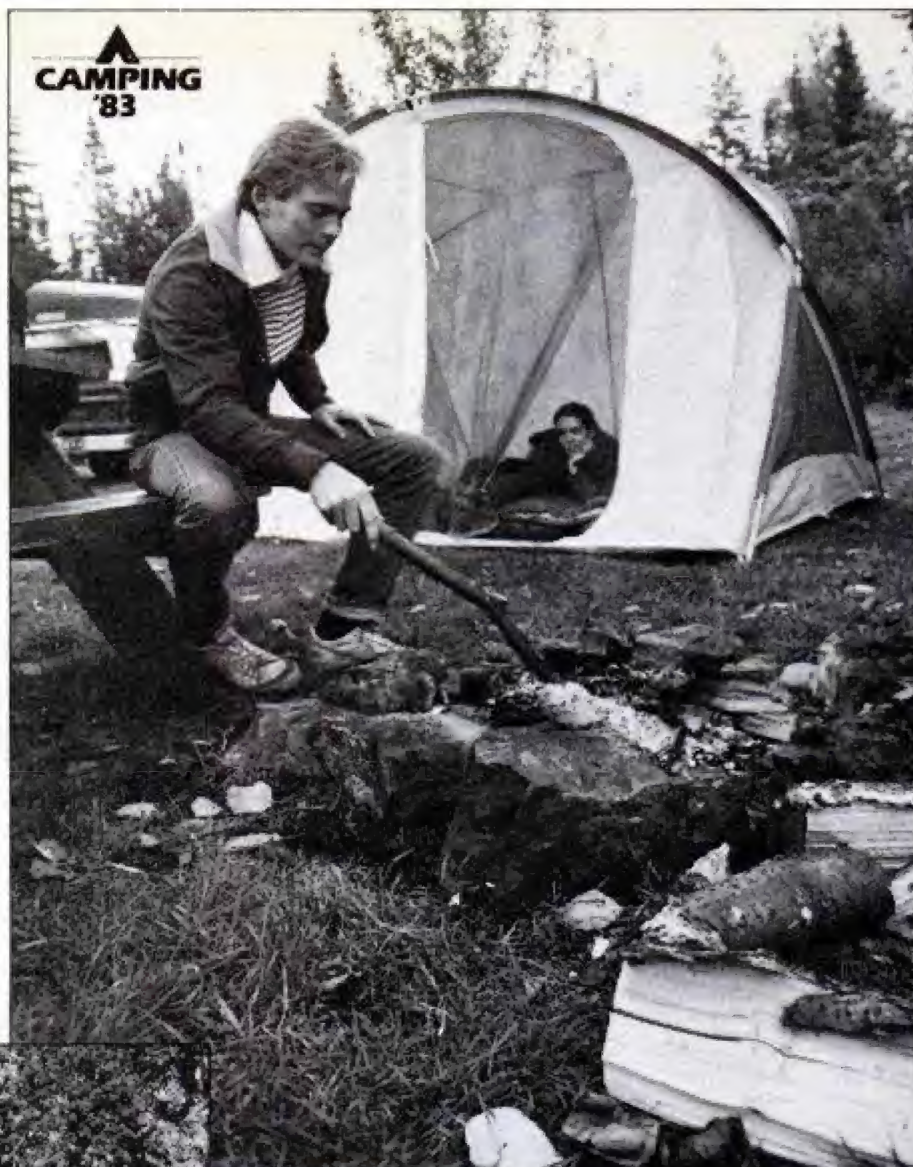
Small tent with big headroom, the Moss Landmark can add waterproof-fly cover.



A geodesic dome that is free-standing with a fiberglass frame, the White Stag Star Dome from Henderson weighs nine pounds.



The Stargazer can sleep two and withstand strong winds. This new White Stag model is for mountains.



CAMPING
'83

Made of Kimberly-Clark's Evolution 3 material, the new 8 x 10 Odyssey from Coleman has two triangular side windows, a D-style door, is free-standing using shockcorded aluminum poles.



Moss's Starlet at only 4½ pounds is free-standing two-sleeper compact with open net top for easy breezes.

tenters to think about this year. Developed at Kimberly-Clark's Neenah, Wis., research facilities as long ago as 1976, Evolution fabric was first introduced in 1981. Jim Mechlin of Kimberly-Clark's Research and Development Center, now at Rosewell, Ga., says, "In 1981, four manufacturers offered eight styles of tents. In 1983, six manufacturers offer 14 styles." Mechlin points out that the body respires eight pints of water in a day. "Five to six people in a tent give off a lot of moisture," he says. "Evolution fabric's high vapor-transmission rate keeps the interior fresher."

Evolution 3, a three-layer laminate of

(Please turn to page 68)

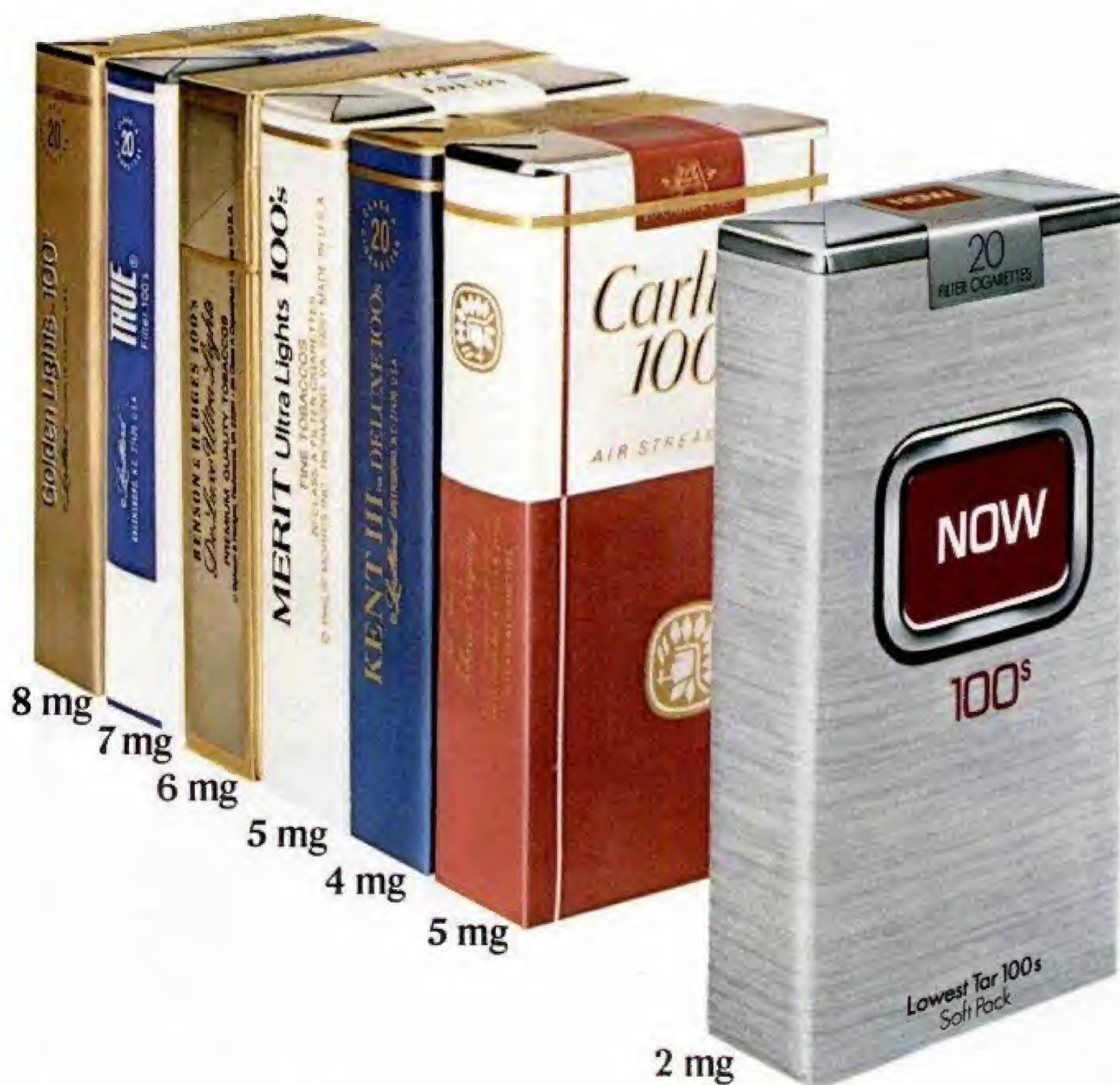
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CAMPING '83

spin-bonded polypropylene, provides superior dimensional stability, thus enabling tentmakers to have greater design freedom. It is highly water repellent, mildew- and rot-proof, acid and stain resistant, and has no odor. The Coleman Co., which in 1981 pioneered the use of Evolution 3 in its Genesis tent, will use it in three family tents.

Other tent innovations include Eureka's roof of no-see-um fabric for its Wisp I and II tents. They also have breathable panels of uncoated Ripstop between floor and roof. Window and door hoods in front and rear allow these air passages to remain partially open in a rainstorm. Black Ice's Meridian tents also provide for air circulation in a rain. Two tunnel vents



New from Eureka Tents, Wisp II is a 4½-pound lightweight Ripstop sleeping two.

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The Olympic, another of the distinctive Moss designs, has handy front vestibule.

are built into the upper canopy, and there is a snow tunnel in the rear. Diamond Brand's Super Spirit 3, a free-standing A-frame, also has a large front door and a standard-size back door which, because of its double vestibule, provides excellent ventilation.

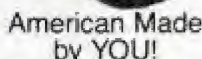
Other new features to look for are lap-folded seams, well-finished fabric edges, and threaded stitch lines for extra strength. Guy lines with automatic tension adjusters provide extra security in a windstorm. There are also inside storage pockets for small objects and laundry-drying loops.

All told, the tents being offered this spring are more versatile, lightweight, easy to erect and better ventilated than ever before. Thanks to designers like Bill Moss, they are also more pleasing to the eye.

PM

\$629⁹⁵

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CAMPING
'83



Now you can take perishables anywhere you go in your car or boat. Ice chests like Model 660 from Norcold, Sidney, Ohio, store frozen food or hold kitchen refrigerator temperatures. Powered by a 12-v.d.c. battery (or 115-v.a.c. household current), Norcold's Refrigerator/Freezer has an automatic temperature control that can be turned down to 0°F. The 660 portable lets you take up to 100 pounds of foodstuffs with you.



Day sacks can carry assorted supplies and rain gear for a hike from camp. The Cordura Model 725 from Coleman's Peak 1 Div. is light, has a waist belt, haul strap, padded shoulder straps, top pocket.



Latest in outdoor clothing is durable, washable, styled for warmth without bulk. The Cordura Model 725 from Coleman's Peak 1 Div. is light, has a waist belt, haul strap, padded shoulder straps, top pocket.



Multipurpose gear saves pack-space and weight. This five-blade knife, the Swedish Kombi Survival Set from Precision Sports, Ithaca, N.Y., can switch blades for sawing, skinning and filleting game.



Solar heating can be easy at a campsite with Solar Spray by Reliance Products, Winnipeg, Man. A five-gallon polyethylene container unfolds to hold shower water that warms up quickly in the sun.



Safari Pack from Rod Hall Racing, Reno, Nev., is a handy car-trunk stow kit for off-road and on. Bungee straps, duct tape, first-aid kit, flares, flashlight, tire gauge and tow strap are included.



Somehow, when you're camping you always need to hold a light when your hands are already full. Berkley, of Spirit Lake, Iowa, now has a new Outdoorsman Lite with stainless steel clip that fits on a cap, clips on a pocket or belt or stands on its own.



Keeping fishing simple was the goal of Mississippi angling champ Eddie Slater, of Indianola, when he designed a lightweight reel of Du Pont Zytel for taping onto any pole. It has adjustable drag, takes lines down to two pounds.

(Please turn to page 72)

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NEW FOR FAMILY CAMPING

(Continued from page 71)



Designed for firm footing while fishing streams with slippery rocks, Red Ball Master wading shoes have felt soles, nylon uppers, sponge collars to keep out sand, space for Bama Socklets, waders.



New tent bags from Coleman, Wichita, Kan., come in sizes for medium and large Coleman family tents. Duffel bags, tent canopies, van conversion kits and seam sealer are also new to the canvas line.

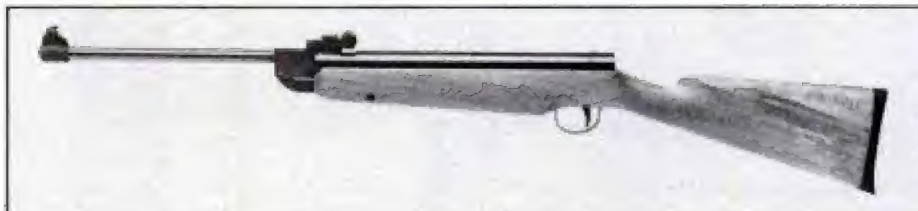
CAMPING '83



For cross-country hiking or orientation sports, Normark, in Minneapolis, has two new compasses with luminous arrows, adjustable grids. Advanced model (right) has conversions for chart, map scales.



Campers and outdoorsmen are collecting and wearing custom-type knives, and Al Mar Knives, Wilsonville, Ore., offers a pair, Pack Rat I and II, you can wear on a belt in a combination scabbard.



For plinking and target practice, Beeman Precision Airguns, in San Rafael, Calif., is producing a short, light, carbine-sized air rifle, the CI, with magnum power of 830 feet per second and a rifled barrel for .177 and .22-cal. pellets.



*Small enough to tow behind mini compact cars with little trunk space or motorcycles with none, the Time Out Cargo Trailer from T.O. Corp., Elkhart, Ind., has a fiberglass compartment of 20 cu. ft. and optional electrical brakes. *(Please turn to page 74)**



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0575	CHILTON AUTO REPAIR 76-83 for all American cars	\$18.95
0932	CHILTON AUTO REPAIR 72-79 for all American cars	\$19.95
7137	CHILTON AUTO REPAIR 64-71 for all American cars	\$19.95
1263	CHILTON AUTO REPAIR 58-63 for all American cars	\$19.95
7111	CHILTON TRUCK REPAIR 75-82 American & import makes	\$19.95
8318	CHILTON TRUCK REPAIR 71-78 American & import makes	\$19.95
8615	CHILTON TRUCK REPAIR 64-71 for all 2-1/2 ton models	\$19.95
8091	CHILTON IMPORT CAR MANUAL 76-83 for all 4-cyl. major makes	\$19.95
0492	AUTO REPAIRS & PRICES list rates times 74-79 U.S. cars	\$7.95
1165	GM CARS Diagnosis & Repair 70-83 plus light trucks	\$14.95
1146	PERFORMANCE WITH ECONOMY power from tuning & building	\$10.95
7125	AUTO AIR CONDITIONING... service & repair all	\$8.95
7126	TRANSISTOR IGNITION SYSTEMS covers them all	\$8.95
7110	WEEKEND MECHANIC'S HANDBOOK deal manual for beginner	\$11.95
9622	HOW TO TUNE YOUR CAR good for all cars	\$5.95
9671	BASIC MAINTENANCE & REPAIR keep your car running right	\$4.95
1212	BASIC AUTO REPAIR MANUAL a must for any car	\$5.95
0702	BASIC BODYWORK & PAINTING	\$6.95
1711	BASIC CARBURETORS & FUEL SYSTEMS for all U.S. makes	\$6.95
1706	BASIC CHASSIS, SUSPENSION, BRAKES tune & service	\$6.95
1708	BASIC IGNITION & ELECTRICAL SYSTEMS	\$6.95
0680	BASIC AUTO TROUBLESHOOTING for all cars	\$6.95
9410	TURBOCHARGERS most complete book on the subject	\$9.95
3759	ELECTRONIC FUEL INJ MAN 70-77 for all imported cars	\$9.95
9976	CARBURETOR BASICS troubleshoot & rebuild all U.S. makes	\$8.95
9411	HOLLEY carbs. all 2 & 4 cyl. tune & rebuild	\$7.95
9652	ROCHESTER CARBURETORS for all 1, 2 & 4 barrel models	\$9.95
9666	SOLEX CARBURETORS all 1 & 2 barrel downdraft models	\$4.95
6354	SO CARBURETORS tune & rebuild all 1976	\$9.50
9473	STROMBERG CO CARBS tune & rebuild all to 1976	\$9.50
1531	WEBER CARBURETORS tune & rebuild all models to 1979	\$8.50
0827	AUTOMOTIVE REFINISHING best professional paint book	\$8.95
5104	AUTOMOBILE REPAIRING & REPAINTING the best	\$14.95
1659	AUTO BODY SHEET METAL REPAIR for professionals	\$14.95
5106	GLASS FIBER AUTO BODY construction & repair	\$6.00
1071	CREATIVE CUSTOMIZING how to do it like a pro	\$6.95
8354	CUSTOMIZE YOUR VAN step-by-step how to Chevy Dodge Ford	\$8.95
3726	ENGINE SWAPPING techniques with actual swaps	\$8.95
8491	PRACTICAL ENGINE SWAPPING how to do it right	\$7.95
6029	DIESEL GUIDE covers everything owner buyer should know	\$8.95
0541	MODERN DIESEL CARS describes all models now sold	\$7.95
7128	DIESEL ENGINES, HOW TO REPAIR, complete training course	\$10.95
8432	DIESEL ENGINES, HOW TO REPAIR, complete training course	\$10.95
9674	DIESEL Fundamentals, Service, Repair covers all aspects	\$19.95
2526	ENGINE REBUILDING all U.S. & imports, gas & diesel	\$14.95
9320	AUTOMATIC TRANS SERVICE 68-79 all Ford & GM models	\$14.95
1745	AUTOMATIC TRANS REPAIR 74-80 AMC, Chrysler, Ford & GM	\$14.95
1223	BRAKES, STEERING, SUSPENSION service all 76-83 cars	\$14.95
9780	AUTO RESTORATION GUIDE best ever published 291 pp	\$15.95
0995	CAR INTERIOR RESTORATION useful for all cars	\$6.95
0996	OLD CAR VALUE GUIDE latest edition	\$9.95
7706	BYPASS EMISSION CONTROLS 73-77 all Ford built cars	\$15.95
8474	BYPASS EMISSION CONTROLS 71-77 GM cars	\$15.95
0813	V-6 PERFORMANCE from Buick, Ford & Chevy V6 engines	\$10.95
9534	POWER POWER MANUAL performance tuning the V6 models	\$8.95
0830	CHEVY SUPER SPORT 61-76 everything about every model	\$14.95
9795	CHEVY PERFORMANCE getting the most from small blocks	\$10.95
8125	CHEVY SMALL BLOCK, how to rebuild	\$9.95
9409	CHEVY SMALL BLOCK, how to rebuild	\$9.95
0949	CORVETTE RESTORATION SOURCE BOOK 53-57 low bid	\$21.95

8127	DATSUN 240Z, 260Z, 280Z 70-78 covers all models	\$12.95
9152	DATSUN 280ZX 79-82 for all models inc turbo	\$12.95
1657	DATSUN 310 76-81 covers all models plus F-10	\$12.95
9581	DATSUN 510, 610, 710 68-77 covers all models	\$12.95
1258	DATSUN 311 sports car 1600-2000 SPL & SR, models	\$20.95
9297	DATSUN PICK-UP 70-82 for all 2-wheel drive models	\$12.95
0925	DATSUN PICK-UP 80-81 for all 4-wheel drive models	\$12.95
0871	DODGE 68-77 for all Minicop & Polara models	\$10.95
8066	DODGE ARIES 81-82 covers all models	\$12.95
1759	DODGE DASH 78-81 covers all models inc D/P	\$12.95
8371	DODGE PICK-UP 65-82 covers all 4-wheel drive models	\$10.95
1798	DODGE PICK-UP 71-81 for all 2-wheel drive models	\$12.95
2497	DODGE D-50 PICK-UP 19-81 all models & Plymouth Arrow	\$10.95
8203	DODGE VANS 67-70 all 1/2, 3/4 & 1 ton models inc Plymouth	\$10.95
6070	DODGE VANS 71-81 covers all models inc 1 ton plus Plymouth	\$12.95
8371	DODGE PICK-UP 65-82 covers all 4-wheel drive models	\$10.95
9688	ESCORT 61-82 covers all models plus Mercury Sprint	\$12.95
8189	FAIRLARK, FORD 62-70 covers all models	\$10.95
8366	FAIRMONT FORD 78-81 covers all models and engines	\$12.95
9874	FALCON, FORD 64-70 covers all 8-cyl models	\$10.95
9776	FIAT 124 67-81 all inc spider coupe & 2000	\$12.95
9776	FIAT 128 72-79 for all models inc SL & Rally	\$12.95
8106	FIAT 131 75-80 for all models, 1.8 & 2.0 line engines	\$12.95
0399	FIAT 117 73-80 covers all models	\$12.95
6022	FIAT STRADA 79-80	\$12.95
1023	Fiesta, FORD 77-80 covers all models	\$12.95
0675	FIREBIRD 67-69 covers all models	\$12.95
6309	FIREBIRD 70-81 covers all models inc Trans Am	\$12.95
9811	FORD 71-82 covers Elite, LTD, LTD Ranchero, Thunderbird	\$10.95
0872	FORD 68-81 for Custom, Galaxie, LTD XL & wagon models	\$12.95
9369	FORD COURIER 72-82 covers all models imported	\$10.95
8205	FORD PICK-UP 65-68 all 2 & 4-wheel drive models 1 1/2 ton	\$12.95
0451	FORD PICK-UP 69-82 covers all 2-wheel drive models	\$12.95
8204	FORD VANS 61-68 for all 1/2, 3/4 & 1 ton models	\$10.95
0453	FORD VANS 69-81 covers all 6 & 8 cylinder models	\$12.95
9436	GRANADA, FORD 75-80 covers all models	\$10.95
0885	HONDA ACCORD 77-80 covers all models	\$12.95
8694	HONDA CIVIC 73-79 covers all models inc Civic	\$12.95
0980	HONDA CIVIC 80-81 covers new models Civic	\$12.95
9787	HONDA PRELUDE 79-80 complete coverage	\$12.95
8206	INTERNATIONAL SCOUT 67-73 800, A, B, D models	\$10.95
8565	INTERNATIONAL 62-80 full maintenance & weight pick-up	\$10.95
1043	JAGUAR E-TYPE 61-77 covers all 5-cylinder models	\$12.95
9612	JAGUAR E-TYPE V12 71-74 covers all models	\$12.95
9637	JAGUAR XJ6 68-79 covers all models	\$12.95
9617	JAGUAR XJ12 72-80 for all models inc XJS, Daimler	\$12.95
9769	JEEP 50-65 for 4 & 6-cyl. station	\$19.95
8207	JEEP 66-79 for all Cherokee, Commando & Wagoneer models	\$10.95
9805	JEEP WAGONEER 1980-81 plus 2300 cc. engine	\$19.95
9806	JEEP UNIVERSAL C-2, C-3 reprint factory manual	\$19.95
0509	JEEP 55-81 for all C-3, C-6, C-7, Scramper models	\$10.95
8739	JENSEN-HEALER reprint of factory manual	\$24.95

0596	LANCIA BETA 76-80 for sedan, coupe & HPE models	\$12.95
1254	LANDROVER 59-77 covers 2, 2.4, 3 gas & diesel models	\$12.95
0481	MAVERICK 69-71 6 cyl 170, 200 250 cu. in. eng.	\$10.95
8211	MAVERICK 72-77 covers all models	\$10.95
1550	MAZDA GLC 77-82 for all rear wheel drive models	\$12.95
0812	MAZDA GLC 81-82 covers front wheel drive models only	\$12.95
0371	MAZDA RX2 & RX3 71-77 covers all models	\$12.95
0444	MAZDA 71-75 includes RX4 and Cosmo models	\$10.95
9941	MAZDA RX7 79-81 covers all models	\$12.95
9486	MAZDA PICK-UP 72-82 all 1.600 & 1.800 models	\$12.95
8105	MAZDA 626 79-81 covers all models	\$12.95
0593	MAZDA RX8, RX9 72-78 covers all models	\$12.95
1746	MERCEDES-BENZ 220 59-65 covers all models	\$12.95
8197	MERCEDES-BENZ 250 65-68 plus 1900 2000 2200 models	\$10.95
9485	MERCEDES-BENZ 250.280 68-72 all models plus 230	\$12.95
0416	MERCEDES-BENZ 280 73-79 covers all models plus 450 & diesel	\$12.95
8439	MERCEDES-BENZ 74-79 covers all models inc Diesel	\$12.95
9436	MERCURY MONARCH 75-80 covers all models	\$10.95
0922	MERCURY ZEPHYR 78-81 all models inc turbocharged	\$12.95
1098	MG MIDGET 68-80 all models plus 4 H Sprint 58-71	\$12.95
1720	MG, MGBGT 69-80 for all roadster & coupe models	\$12.95
0912	MINI 59-78 covers all models inc Mini Cooper	\$12.95
0884	MONZA, CHEVROLET 75-80 plus Astro Starline Skyhawk	\$10.95
9976	MUSTANG 65-72 covers all 5-cylinder models	\$12.95
0479	MUSTANG V8 65-73 covers all models	\$12.95
8272	MUSTANG 74-78 covers all 4, V6, & V8 models	\$12.95
9386	MUSTANG 79-82 covers all engines and models	\$12.95
0951	NOVA, CHEVROLET 71-79 covers all models	\$12.95
7107	OLDS CUTLASS 70-81 covers all models & engines	\$12.95
9148	OLDS OMEGA 80-81 all models plus Pontiac Phoenix	\$10.95
6308	OLDSMOBILE 68-76 covers all 88 & 98 models	\$12.95
8273	OPEL 66-79 for all models inc 1900 Marita & Insignia	\$12.95
9589	OPEL GT 68-73 covers all 1900 models	\$12.95
0711	PEUGEOT 504 DIESEL 74-80 covers all models	\$12.95
7124	PEUGEOT 504 68-79 for all gasoline engine models	\$12.95
0883	PINTO 70-80 covers all models inc Mercury Bobcat	\$10.95
0874	PLYMOUTH 68-76 Fury, VIP, Gran Suburban models	\$10.95
1759	PLYMOUTH HORIZON 78-81 covers all models inc TC3	\$12.95
8066	PLYMOUTH RELIANT 81-82 covers all models	\$12.95
0851	PONTIAC 66-76 all 4-cyl. inc Bonneville, Catalina, GP	\$12.95
0489	PONTIAC TEMPEST 68-73 all models inc GT, Le Mans	\$10.95
8173	PORSCHE 911 70-77 all models inc T, T E, S & Carrera	\$12.95
9535	PORSCHE 911 78-81 covers all models inc SC	\$12.95
1590	PORSCHE 912 65-69 with 1582cc engine	\$12.95
9834	PORSCHE 914 70-76 all models inc 914 S	\$12.95
0993	PORSCHE 924 76-80 covers all models inc Turbo	\$12.95
8008	PORSCHE 928 78-81 also covers 924	\$12.95
9271	RENAULT 11 Car 72-82 for all models inc RS	\$12.95
9429	RENAULT 12 65-79 covers all models inc auto trans	\$12.95
0845	RENAULT 15, 17 71-79 covers all models inc TL, TS	\$12.95
0506	RENAULT 18 78-81 all models inc TL, TS, LS, GT, GTS	\$12.95
0395	ROADRUNNER & SATELLITE 68-73 all models	\$10.95
0750	SAAB 99 69-79 covers all models	\$12.95
8058	SUBARU 72-81 for all models inc Brat	\$12.95
0845	SUNBEAM TIGER 260 & 289 reprint of factory manual	\$24.95
8189	TORINO 68-73 all models inc Elva, Ranchero	\$10.95
0829	TOYOTA CELICA 71-80 covers all models	\$12.95
9812	TOYOTA COROLLA 68-81 for all models inc 3-sp. trans	\$12.95
7137	TOYOTA CORONA 70-82 covers all 4-cyl models	\$12.95
8198	TOYOTA CRESSIDA 77-82 covers all models	\$12.95
0847	TOYOTA PICK-UP 68-81 for all 2-wheel drive models	\$12.95
8524	TOYOTA LAND CRUISER 66-77 covers all models	\$12.95
0923	TOYOTA STARLET 78-81 covers all models	\$12.95
0576	TOYOTA SUPRA 79-81 covers all models	\$10.95
0901	TOYOTA TERCEL 80-82 covers all models	\$12.95
1200	TRIUMPH SPITFIRE 62-78 covers all models	\$12.95
1015	TRIUMPH TR6, TR6, 76-78 covers all models inc TR250	\$12.95
8693	TRIUMPH TR7 75-80	\$12.95
8192	VALENT 68-76 all models inc Scenic, Signet	\$10.95
0844	VEGA 74-77 all models inc Monza except Coloworth Vega	\$10.95
8019	VOLARE 76-80 covers all models	\$10.95
1127	VOLKSWAGEN BEETLE 64-67 all models inc Karmann Ghia	\$12.95
0140	VOLKSWAGEN BEETLE 68-77 all models inc Karmann Ghia	\$12.95
8300	VOLKSWAGEN RABBIT 75-82 gas & diesel plus pick-up	\$12.95
8294	VOLKSWAGEN SCIROCCO 75-82 covers gas & diesel models	\$12.95
8383	VOLKSWAGEN JETTA 80-81 all models inc other VW models	\$12.95
1129	VOLKSWAGEN BUS 61-79 all campers, vans, transporters	\$12.95
9587	VOLKSWAGEN TYPE 2 67-73 for all models inc Karmann Ghia	\$12.95
9778	VOLKSWAGEN 411, 412 68-74 covers all models	\$12.95
8749	VOLKSWAGEN DASHER 74-79 covers all models	\$12.95
1754	VOLVO 142, 144, 145 66-74 for all models inc S & E	\$12.95
9558	VOLVO 164 65-75 for all models inc fuel injection	\$12.95
3729	VOLVO 242, 244, 245 74-82 covers all models	\$12.95
8311	VOLVO 264, 265 75-80 covers all models	\$12.95

GET YOUR KNIFE READY FOR FISHING SEASON

Smith's

**CERAMIC
SHARPENING
STICKS**

**SHARPENS
KNIVES
QUICKLY**

Smith's THE SYMBOL OF SHARPENING

"AVAILABLE ANYWHERE KNIVES ARE SOLD"

Smith's Whetstone Inc. — Hot Springs, Arkansas 71901

Giant Heavy Duty Inflatable Boats

**2 MAN
\$38**

**3 MAN
\$50**

**4 MAN
\$65**

Before Midnight May 1

Viking Ind. will send any of the above size boats to any reader of this publication who reads and responds to this program before midnight, May 1. Each boat is constructed of tough, high density fabric (resistant to abrasion, sunlight, salt & oil), electronically welded embossed seams, nylon safety line grommeted all around, heavy duty oar locks, three separate air chambers for extra safety, self locking safety valves, bow lifting and towing handle, and are recommended for marine, ocean, and fresh water recreation, camping, fishing, or a family fun boat, and will be accompanied with a LIFETIME guarantee that it must perform 100% or it will be replaced free. Add \$7 handling and crating for

each boat requested, Viking Ind. pays all shipping. If your order is received within the next ten days you will receive FREE a high volume combined hand/foot inflator/deflator bellows style pump for each boat requested. Should you wish to return your boats you may do so for a full refund. Any letter postmarked later than May 1 will be returned. LIMIT: Three (3) boats per address, no exceptions. Send appropriate sum together with your name and address to: Boat Dept. #117CR, Viking Ind., 6314 Santa Monica Blvd., Los Angeles, CA 90088, or for fastest service from any part of the country call collect before midnight 7 days a week.

CALL COLLECT (213) 462-1914
(Ask exchange operator for)
BOAT DEPT. #117CR
Before midnight, 7 days a week
Have credit card ready

NEW

(Continued from page 72)

**CAMPING
'83**



Walking over slick ground, ice or underwater mossy rocks when fishing is easier with accessory traction chains from Saf-T Shoe Chains, Mount Prospect, Ill. Shoe Chains fasten easily to any shoes or boots with rubber loops, and are available in both standard and heavy-duty models.



New Sporting Glasses from Hoppe's, the maker of No. 9 Solvent for gun cleaning, now come with clear, yellow and smoke-gray lenses and side shields. The glasses provide eye protection for home hobbyists, shooters, industrial workers, and come with a protective belt case.



Double-sized for double-up sleeping in the back of a station wagon, camper or travel trailer, the White Stag Wagon model sleeping bag from Henderson Camp Products, Chicago, has 4 pounds of Dacron Hollofil 808 insulation: 1½ pounds on top, 2½ pounds below. **PM**

For 1983, Chrysler increases its warranty protection to two years.

Only one major outboard manufacturer has enough confidence in its product quality and reliability to offer a limited warranty for not one, but two years. That's Chrysler Marine.

For 1983, all domestic outboards, purchased from authorized U.S. Chrysler Marine dealers, will carry a 2-year limited warranty against defects in materials and workmanship on the entire product. Both parts and labor.*

America's longest warranty. America's lowest dealer prices. It's not surprising that

Chrysler Marine leads the industry in warranty protection. Chrysler is a leader in bringing design simplicity/easy maintenance to outboard engines. And model for model, Chrysler offers its dealers the lowest wholesale prices of any major manufacturer. So, our dealers can pass along important outboard savings to you.

Exciting new graphics . . . new models highlight Chrysler's '83 lineup. Chrysler Marine outboards feature attractive new graphics, designed to complement any craft. Choose from a complete lineup of 1983 performers from the 3.5 to the 140 HP, including three of the highest-thrust sailor engines designed for displacement hulls.

And introducing the Charger 90. A real high-torque powerhouse with stainless steel prop, standard.

Our 1983 outboard lineup is the product of over 50 years of engineering innovation, testing and in-use proving.

Compare. Nobody pulls it all together like Chrysler Marine to give you price, warranty, quality and serviceability.

See your Chrysler Marine dealer now.

*Excludes normal maintenance service and parts, and outboards that are part of boat builder packages. \$25 deductible required in second year. See dealer for details.

NOW FROM CHRYSLER MARINE: THE INDUSTRY'S LONGEST OUTBOARD WARRANTY.



CHRYSLER MARINE

Where To Go— What To Take

CAMPING
'83

For the family heading out with no idea where they'll camp for the night, the trip can be a pleasant adventure—or the source of a lot of worry. Planning ahead is important. Contact the tourist departments at state capitals for descriptions of campsites and points of interest. Consult the guides listed here and write or phone ahead for reservations.

But sometimes plans change. Fishing may be good at the lake and you want to stay several extra days. Rain may be making the children restless and you want to move on to a campground that has indoor

playground activities. One or more of the directories below should go along in your car or RV as part of your traveling equipment.

The camping gear you choose will also make the difference between a delightful time and a disaster. Tents that leak or blow down, sleeping bags that are cold and get wet, boots that create blisters can often be avoided if you stick with quality. Yet the best equipment items are as near as your mailbox after you study the mail-order catalogs described below. Use this directory of directories as insurance.

Camping

Rand McNally Campground & Trailer Park Guide For The United States, Canada and Mexico; \$10.95.

Rand McNally Campground & Trailer Park Guide, Eastern Edition; \$6.95.

Rand McNally Campground & Trail-



er Park Guide, Western Edition; \$6.95.

Trailer Life Campground and Service Directory; \$11.95.

Woodall's Campground Directory, covering the United States, Canada and Mexico; \$10.95.

Woodall's Campground Directory, Eastern Edition; \$8.95.

Woodall's Campground Directory, Western Edition; \$8.95.

National Park Guide, by Michael Frome; Rand McNally; \$8.95.

Rand McNally Backpacking & Outdoor Guide, Richard Dunlop; \$6.95.

K O A Campground Directory; \$1 at K O A Campgrounds or from Box 30162, Billings, Mont. 59107.

10 Destinations

North to the Viking Past: Superintendent, Gros Morne National Park, Box 130, Rocky Harbor, Newfoundland A0K 4N0.

Spelunking in Carlsbad's Wild New Cave: Superintendent, Carlsbad National Park, 3225 National Parks Highway, Carlsbad, N.M. 88220.

Crater of Diamonds: Superintendent, Crater of Diamonds State Park, Route 1, Box 324, Murfreesboro, Ark. 71958.

Boat Camping in Glacier Bay National Park: For reservations on *Glacier Bay Explorer*, write Exploration Holidays and Cruises, 1500 Metropolitan Park Bldg., Olive Way at Boren Ave., Seattle, Wash. 98101.

Backpacking in the Porkies: Porcupine Mountains State Wilderness Park, Rte. 2, M107, Ontonogan, Mich. 49953.



Wild Ponies of Assateague: Assateague Island National Seashore, Rte. 2, Box 294, Berlin, Md. 21811.

Cajun Lagniappe: Chamber of Com-

merce, City Hall, Civic Center, Box 27, New Iberia, La. 70560.

Okefenokee Canoeing Trails: Stephen Foster State Park, Fargo, Ga. 31631.



Biking in Vermont: American Youth Hostels, 1332 I St. N.W., Washington, D.C. 60005.

Trail Riding in the Big Bend: Big Bend National Park, Tex. 79834.

Equipment sources

Eddie Bauer: Box 3700, Seattle, Wash. 98130; quality cold-weather clothing, sleeping bags, accessories.

L.L. Bean: Freeport, Me. 04033; famous for rubber-bottomed Maine hunting shoe and wide assortment of camping and outdoor gear by mail and from retail store that never closes.

Cabella's: 812 13th Ave., Sidney, Neb. 69162; hunting, fishing, camping gear.

Campmor: Box 999N, Paramus, N.J. 07652; wide choice at bargain prices.

Dunn's: Box 449, Grand Junction, (Please turn to page 79)

"4X4 OF THE YEAR."

NEW-SIZE CHEVY S-10 BLAZER

This never-before sport utility vehicle has been named "4X4 of the Year" by *4-Wheel & Off-Road* magazine, plus "Four Wheeler of the Year" by *Four Wheeler* magazine. And now Chevy S-10 Blazer is taking on Ford's brand-new Bronco II—with some decided advantages.

4-cyl. or optional V6 power. A standard 4-cyl. engine or available V6. Ford Bronco II offers only a V6.

Insta-Trac 4X4—or 2WD. Every S-10 Blazer 4X4 has the revolutionary Insta-Trac 4X4 system. For the first time ever, you can shift from freewheeling, fuel-efficient 2-wheel drive to 4-wheel-drive High—and back—at any speed. Ford Bronco II offers nothing like it. A 2-wheel-drive S-10 Blazer is also available.

Highest towing capacity in its class: 5000 lbs.

Including trailer and cargo. That's 950 lbs. more than a Ford Bronco II with a V6. Optional V6 and heavy-duty trailering package are required.

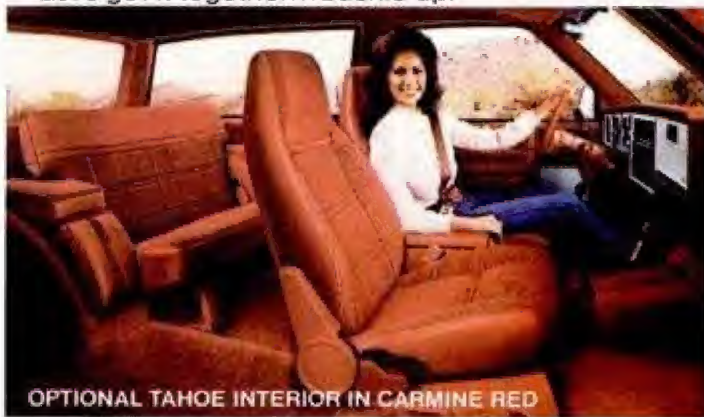
More options Bronco II doesn't offer. They include big, fat P235/75R-15 on/off-road tires, power windows, power door locks, and much more.

More payload capacity and cargo room than Bronco II. With the available rear seat folded down, you get long cargo length (68.6 inches) and big cargo space (67.2 cubic feet). Plus a 1000-lb. payload capacity. Payload includes people and cargo.

The Chevy S-10 Blazer 4X4 with optional V6 and 4-speed manual transmission has some impressive mileage figures, too. 31 Est. Hwy., [21] EPA Est. MPG.* Chevy S-10 Blazer—the "4X4 of the Year"! See it soon at your local Chevy dealer's.

*Use estimated MPG for comparisons. Your mileage may differ depending on speed, distance, weather. Actual highway mileage lower. Estimates lower in California. Some Chevrolet trucks are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your dealer for details.

Let's get it together...buckle up.



TOUGH CHEVY TRUCKS ARE TAKING CHARGE

CHEVY S-10 BLAZER 4X4



OUR OUTDOOR LINE COMES IN SMALL, MEDIUM AND LARGE.

Honda can give you all the power you need for good times in the great outdoors. With a complete line of lightweight, portable generators from 500 to 800 watts. Each is really easy to operate. Just turn it on, pull the cord and you're off and running.

Honda generators are ideal

for lighting up a campsite, charging the boat battery, powering small appliances, or providing standby power.

Each one features a quiet, reliable Honda four-stroke engine. An advanced Oil Alert™ system that warns when the oil level gets too low.* An Automatic Decompression system

and CD Ignition for quick, easy starts. And a USDA approved spark arrestor muffler so it can even be used in National Parks.

So if you're looking for the best generator to fit your outdoor power needs, size up a Honda.

Check your Yellow Pages for the Honda Generator dealer nearest you today.

*Except on EM500

©1983 American Honda Motor Co., Inc. For optimum safety and performance, we recommend that you read the owner's manual before operating your Honda Power Product.

IT'S A HONDA

Моторная, автомобильная, генераторная продукция

WHERE TO GO

(Continued from page 76)

Tenn. 38039; hunting clothing and equipment, plus accessories for dogs.

Early Winters: 110 Prefontaine Place S., Seattle, Wash. 98104; extensive selection of clothing, gear, gadgets.

Eastern Mountain Sports (EMS): Vose Farm Rd., Box 811, Peterborough, N.H. 03458; cold-weather clothing and gear from store chain and by mail.

Frostline Kits: Frostline Circle, Denver, Colo. 80241; sew-it-yourself items, many of them down-filled.



Indiana Camp Supply: Box 344, Pittsboro, Ind. 46167; camping accessories and books, plus extensive wilderness medicine kits.

Lands' End: Lands' End Lane, Dodgeville, Wis. 53533; outdoor and boating clothing, bags.

P & S Sales: Box 45095, Tulsa, Okla. 74145; outdoor clothing, equipment and supplies, plus some bargain surplus items.

Patagonia Software: Box 150, Ventura, Calif. 93002; the clothing division of the Great Pacific Iron Works, makers of Chouinard technical-climbing gear.

Recreational Equipment (REI): Box 88125, Seattle, Wash. 98188; a cooperative with extensive outdoor and mountaineering equipment that pays divi-



dends to members purchasing gear.

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9 mg. "tar", 0.8 mg. nicotine av. per cigarette, FTC Report Dec. '81.

FIRSTHAND REPORT

Slick, aerodynamic styling, light weight and first-rate engineering have made Sierra the terror of the Autobahns. It will arrive here in 1985.



Driving The European Ford Sierra

Going one-on-one with Mercedes and BMW—and winning convincingly!

BY RICH TAYLOR

PM photos by the author

The heart of the worldwide automobile market is what Germans call the "1,000-kilogram class," four-door sedans that weigh between 2,000 and 2,500 pounds, carry four passengers, are driven by roughly two-liter engines and cost \$8,000 to \$12,000. Because this niche is so big and important, it's terrifically competitive. If your entry has been on the market more than a year or two, it's already outdated.

The upscale end of the 1,000-kilogram class is dom-

inated by the Germans—the revamped BMW 3-series, the all-new Mercedes-Benz 190/190E (see *Firsthand Report*, page 105) and most important of all, the knockout Ford Sierra. If you think a BMW can cut around a corner, try a Sierra. If you think a Mercedes is quiet and smooth, try a Sierra. If you think a Mazda 626 is filled with electronic wonderment and inexpensive for what

you get, try a Sierra. Not to put too fine a point on it, Ford's Sierra is not only the best car in the 1,000-kilogram class, it's one of the best sedans in the world.

Now you have to understand about the German market. In Germany, the 3-series BMWs which Americans think of as expensive sports sedans cost about \$9,000 to \$12,000. The new Mercedes, which will cost \$24,000 in the United States, starts at \$11,500 in Germany. Ford's Sierra is priced from \$6,000 for a real stripper to slightly under \$12,000 if you order the full-tilt version. In other words, it's directly competitive with BMW and Mercedes.

It's pretty hard to ignore the Sierra's aerodynamic body. Where BMW is ultra-conservative and Mercedes-

(Please turn to page 82)



XR-4 has biplane rear spoiler, which lowers Cd from .34 to .32.

DRIVING FORD SIERRA

(Continued from page 81)

Benz is, well, Mercedes-Benz, Ford has gone out on a limb to build the most futuristic-looking sedan in production. What other manufacturers are showing as their styling studies for the Year 2000, Ford of Europe is building now. This must have taken some pounding to get through the product planning meetings, and the Fordvok must be biting their nails to see if the car is going to be a success.

Well, if it's any consolation, I drove all over Germany for 10 days in the

Sierra, and everywhere I went, the car was a sensation.

Fighting off buyers

People literally can't keep their hands off it. I finally gave up trying to photograph the Sierra in a Cologne park on Sunday morning—every passerby felt compelled to caress the car, despite my protestations. If that's any indication, Ford dealers are going to be fighting buyers off with a stick.

The slick body not only looks terrific,

it works superbly. Aerodynamic drag coefficient is .34, which is as clean as any production sedan in the world, and by adding a pair of rear spoilers, which Ford mounts on its XR-4 high-performance version, it can reach .32 Cd. But unlike some cars with ultra-aero bodies, the Sierra is not disturbed by side winds or high speeds. I saw a genuine 193 km/hr (120 mph) on the rain-swept



Cockpit is loaded with instrumentation and there's ample room for four adults.

Autobahn to Frankfurt, and the Sierra felt as stable as a Pinto sitting in your driveway.

I interviewed Ford chief engineer Hans-Georg Gaffke, who was in charge of the Sierra program. Says Gaffke, "The devil sits in the details." Look closely at the Sierra, and you can see what he's talking about: the flush fitting windows, door handles and trim, the "moon disc" wheelcovers, even the way most wind-catching body seams have been eliminated through new assembly and stamping techniques.

A people-mover

Even more remarkable, the Sierra's high-aero body works as a people-mover. I fitted three American businessmen inside, and everyone commented on the generous head, shoulder and leg-room—including a 6-foot-6 publisher wearing cowboy boots. He said, "This is the *only* car I've ever been in where I feel truly comfortable."

Fortunately, Ford's interior designers have met the challenge of the body with an equally futuristic interior. The nubly cloth bucket seats are as comfortable as Recaros—the accepted standard of excellence in automotive seating—and infinitely adjustable. The rear quasi-buckets have a 60/40 split, which fold down to give the high-tailed fastback the effective carrying capacity of a station wagon.

The dash layout and controls are near perfect, from the fat-rimmed steering wheel to the nicely located shifter. There's a full set of instruments in front of the driver, plus an onboard computer with digital readout for fuel economy, trip mileage and service intervals. There are power windows,

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power door locks, electric mirrors and every other gadget that the Japanese have led us to expect on a 1,000-kilogram car, including a terrific digital radio.

Chief engineer Gaffke tried both front-wheel drive and rear-wheel drive chassis before deciding to go with a conventional layout. As he points out, BMW and Mercedes both went through a similar test program before also deciding on rear-wheel drive. His arguments are persuasive: better weight distribution, elimination of front torque steer, straightforward maintenance and the ease in which different power trains can be plugged in.

Many engines offered

The Sierra is offered with an incredibly wide range of engines: 1.3, 1.6 and 2.0-liter Fours; 2.0, 2.3 and 2.8-liter V6s and a 2.3-liter diesel—all with four-speed, five-speed or automatic gearboxes. The top option is a fuel-injected, 150-hp version of the 2.8-liter V6 which Ford of North America used to offer in the Capri, and which is now to be available in Ranger trucks.

The Sierra's suspension is remarkably straightforward, with MacPherson struts at the front and independent swing axles on semitrailing arms at the rear. It all works superbly, however, because of some clever engineering with rising-rate polyurethane bump stops and basic suspension geometries. The Sierra feels safe as a house at 120



Base Sierra comes with a 1.3-liter Four and a starting price of \$6,000 in Europe.

mph, and has a marvelously compliant ride over Belgian block and inner city potholes.

A U.S. version

As Gaffke says, "When we brought the Sierra to Arizona for testing, American people said to us 'Holy Smoke, why can't we have these cars?'" Well, in a manner of speaking, we can. Lincoln-Mercury is going to bring some version of the Sierra into the country starting in 1985. According to Gaffke, there will be only 20,000 to 50,000 units. And according to rumors from Detroit, these will all be dressed-up XR-4 versions, with a Brazilian-made, turbocharged 2.3-liter Four and a Mercedes-like price tag of \$24,000.

That's a damn shame. The nicest Sierra is the five-door hatchback, with the 2.8-liter V6, an engine which Ford has already certified for the United States. Thousands of these V6s are already driving around U.S. highways, and Ford mechanics and parts people are already familiar with them. If Ford people wanted to do themselves a favor—and us, at the same time—they'd import the Sierra V6 by the hundreds of thousands, and sell it for \$12,000.

Even better, they'd build them over here. Know why that will never happen? Because while chief engineer Hans-George Gaffke was developing the best sedan in the 1,000-kilogram class, Ford engineers in Detroit were creating the Tempo/Topaz, a car that is not nearly as capable as the European Ford Sierra. The Tempo/Topaz isn't quite in the same ballpark when it comes to quality, sophistication, performance or handling. But it, too, weighs 1,000 kilograms. **PM**

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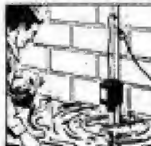
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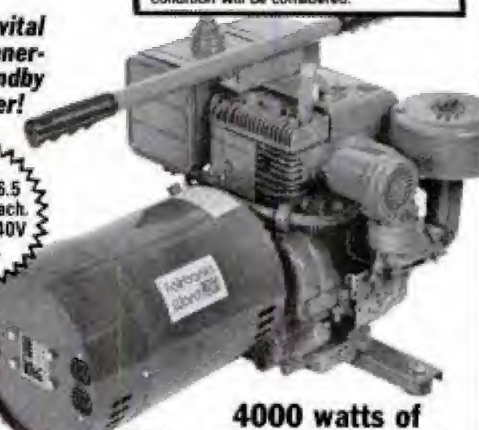
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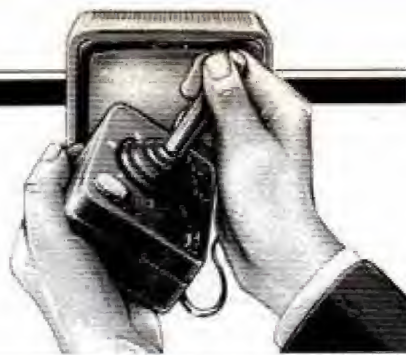
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PM VIDEO MONITOR



Atari 5200—first impressions

Atari's new 5200 is a bright explosion of sound and color, fast moving graphics and stunning capabilities. From the design of the slick, Lucite case to the electronic maze of a full, 64K memory inside, this 5200 is one mean, powerful gaming machine.

Many fine details all add up to a worthwhile new addition to the gamer's choice of possibilities. The joystick, for example, features new engineering techniques that make it easy to control on-screen movement. The stick itself moves in a smooth, noncentering manner that becomes second nature after a few minutes. Atop the stick on the hand controller are three buttons—START, PAUSE and RESET. The PAUSE button is great when the phone rings, just when you're about to reach that all-time high score. The keypad below the stick features real keys and the whole unit fits the hand like an electronic glove.

Cartridges include such coin-op arcade favorites as *Galaxian* (shown) and *Star Raiders*. That's right, a full version of *Star Raiders* on a gaming system!



Swarms of aliens swoop by in Galaxian (above) running on new Atari 5200 machine (right). Hand controllers feature a smooth joystick, as well as a full keypad of switches—even START PAUSE and RESET buttons (inset) so you can stop the action when you want.



One of the most complex, challenging and visually exciting of all video games, *Star Raiders* was responsible for selling a lot of Atari 400 and 800 computers. Now, we predict, it'll sell even more 5200s.

While there aren't yet as many cartridges as one might hope, there's no doubt that Atari and other manufacturers will rush to support the 5200. As always, Atari is a video force to reckon with.—N.S.

Coleco's expansion modules

Colecovision has made a point of featuring games that look as close to their arcade counterparts as possible. For the most part, the company has succeeded admirably. *Zaxxon*, *Mouse Trap*, *Venture* and others feature the

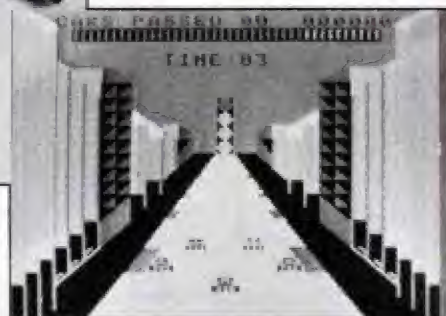
same scintillating graphics and addictive play value as the arcade versions.

Now, Coleco has taken its game machine two steps further with its first two expansion modules.

Expansion Module Two features a small-size but maneuverable steering wheel and a real gas pedal. Plant the plastic pedal deep into your shag rug's pile, grip that tiny wheel and drive into the screeching world of *Turbo*. Like the coin-op game,



Coleco's Expansion Module Two adds a steering wheel and a plastic gas pedal (not shown) to Colecovision game. With these options, the fast-paced Turbo game (right) puts you in the driver's seat.



Turbo is as close to driving a souped-up race car hell-bent through city streets and around treacherous curves as most of us will ever want to come. It seems almost impossible that the three-dimensional graphics can move so fast and so convincingly on the home TV set. If you've ever doubted that any home video game could duplicate the thrill and wet-palm feeling of arcade play, try Colecovision's *Turbo*.

Right now, *Turbo* is the only cartridge available for use with the steering-wheel module. But more driving games loom just around the bend.

And let's not forget Expansion Module One, which lets you use all the Atari 2600 cartridges. We've tried it out and have yet to find a cartridge it wouldn't accept. So, while Atari is less than thrilled with Coleco for doing this (it is, in fact, suing Coleco), there's no doubt of the module's consumer value. If you have a library of Atari 2600 games, Coleco wants you to use them—on Colecovision.—N.S.

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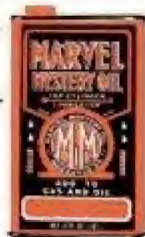
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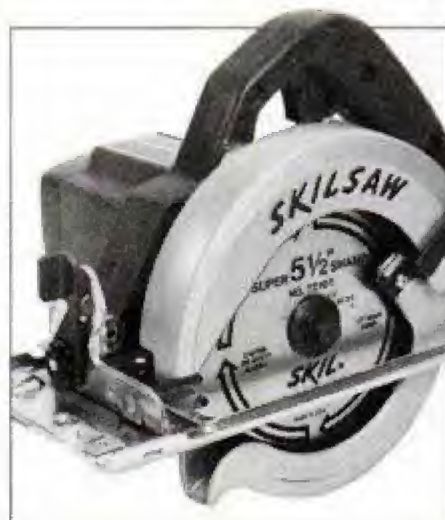


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Some features you will appreciate include an adjustable line-of-cut gauge which can be aligned for the blade in use regardless of kerf width, and sensible, heavy-duty, lock-lever depth and bevel adjustments which are easy to set, with clearly visible calibrations in ¼-in. increments.

The heavy-gauge steel wraparound foot is quite rigid and it doesn't flex under heavy hand pressure. The high-torque, 6.5-amp. motor is burnout protected and is mounted to the right with the blade on the left for good visibility of the cutting line (for the majority of right-handers). The 5½-in.-dia. blade gives a maximum depth of cut at 90° of 1-23/32 in. and 1-5/16 in. at 45°.

We were impressed with this saw and think you will be, too. Skil's 551 Trim Saw is priced at \$89.95, but you may find it for a few dollars less in some areas.

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—Rosario Capotosto and Harry Wicks



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RALEIGH LIGHTS

THE JEEP IS DEAD, LONG LIVE THE HMMWV!

It stands for High-Mobility, Multipurpose, Wheeled Vehicle—so devastating a 4×4 it could very well make the Army forget that there ever was a jeep.

BY MURRAY RUBENSTEIN

After more than 40 years of faithful service, the historic Army jeep is being retired, put out to pasture. How do you say goodbye to the end of an era, to the last days of an old friend? Since 1940, the jeep has stood as a symbol of Yankee guts and ingenuity—a runty little battlefield workhorse that was tough, dependable, easy to maintain, seemingly immune to the indignities of war, and ultimately beloved by all it touched, from foot-weary GIs to four-star generals.

Throughout World War II, the vehicle known officially as the M151 ¼-ton truck served with distinction on every front, in every branch of the armed services, and with every one of our Allies, including the Russians (who loved it, but

couldn't quite accept the fact that it was not made in the U.S.S.R.). Later, it soldiered on in Korea, Vietnam, Africa, the Middle East and many other remote and inhospitable outposts far from home. Along the way, it spawned a new breed of rugged, sporty, off-road civilian vehicles—the ubiquitous 4×4s that are popular today the world over.

Now the military jeep is being replaced. But why? If it's been so good for so many years, why get rid of it? The answer lies in the changing needs of war. For its day and purpose, the jeep was unsurpassed. But modern weapons systems have become bigger, heavier and more sophisticated, requiring larger crews to

Jeep successor: New HMMWV mounts 40-mm grenade launcher, can also fire antitank missiles. Shown is AM General's entry, one of three in stiff Army competition.



Wide variety of HMMWV configurations can be seen here and on facing page—all interchangeable on same chassis using add-on kits. At right are General Dynamics' mobile command post, fitted with sophisticated communications and detection gear, and its Hellfire missile carrier. Photo at far right shows GD's air-cooled diesel and swing-up hood that fully exposes engine and running gear for easy field servicing. Below are two ambulance modes—Teledyne's four-litter "mini" rig (top) and AM General's eight-litter "maxi" rig (bottom). Teledyne version has telescoping body that, when lowered, permits transport by helicopter.



MOBILE COMMAND POST



FOUR-LITTER
'MINI' AMBULANCE



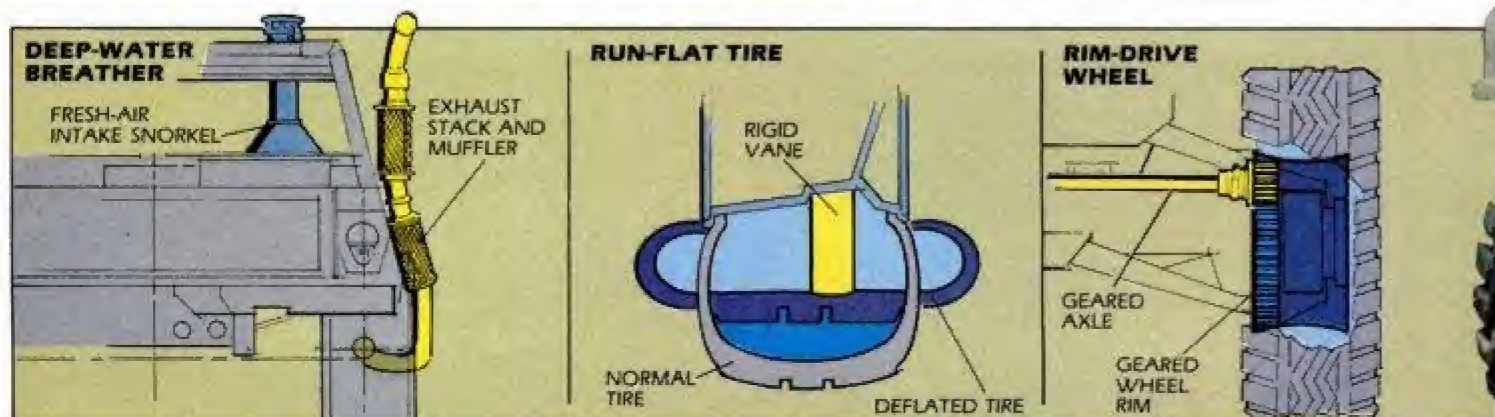
EIGHT-LITTER
'MAXI'
AMBULANCE

man them and more auxiliary equipment to support them. Handling the TOW missile launcher, for instance, now requires two jeeps and a support trailer. The TOW (for Tube-launched, Optically tracked, Wire-guided missile) is the most powerful antitank weapon used by the infantry, and a single carrier for it is vitally needed. Other modern-day gear is also straining the little 4×4 beyond its practical limits.

While the jeep has a rated payload capacity of 1,200 pounds, it can actually carry only about 800 pounds when operating cross-country, and then not at top speed. In addition, the current jeep population is getting old. Of the 58,152 now in the Army's inventory, more than 20,000 are over 12 years old, their normal life expectancy. By 1985, more than 40,000—almost all of the present supply—will be nearing the end of their usefulness.

In 1980, faced with these grim prospects, the Army conducted a study of

Key survival features are shown below. Deep-water breather system (left) has extended intake and exhaust stacks that permit HMMWV to ford streams up to 5 feet deep. Run-flat tire (center) has rigid internal vane that continues to support vehicle if casing is ruptured. All three HMMWV contenders offer these two features. At right is AM General's rim-drive wheel, a clever innovation that raises axle to achieve high ground clearance with low overall silhouette.





HELLFIRE MISSILE LAUNCHER



**AIR-COOLED
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tactical vehicle requirements and concluded that, instead of replenishing its aging jeep fleet with more of the same design, what was really needed was a completely new vehicle. It would be larger, faster and more powerful than the jeep, with a considerably greater payload, more multi-role versatility, increased battlefield mobility and improved combat survivability. Instead of the jeep's relatively light $\frac{1}{4}$ -ton rating, it would have a hefty $1\frac{1}{4}$ -ton capacity (sometimes referred to as a $\frac{3}{4}$ -ton rating).

The Army's designation for this ambitious new

concept is HMMWV (for High-Mobility, Multipurpose, Wheeled Vehicle). The closest you can come to pronouncing this mouthful of consonants is "Hum-vee," a name not likely to stick once imaginative and irreverent GIs get their hands on the vehicle.

But by whatever name the Humvee will come to be known, its advance notices are impressive. Like the jeep, it will have four-wheel drive, but the sim-

ilarity stops there. It will be longer than a jeep (195 inches compared to the jeep's 133), yet it will be several inches lower, making it less vulnerable to enemy ground fire. The Humvee will carry a 2,500-pound payload under combat conditions—three times the jeep's capacity. Designed to satisfy a wide range of battlefield requirements, it will also be a multiservice vehicle, serving the requirements of not only the Army, but the Marines and the Air Force, as well.

Using interchangeable body kits, the basic Humvee chassis


(Please turn to page 174)

Pop-up gun turret can be raised and ready to fire in only seconds. It swivels 360°, takes TOW missile (shown here on AM General's Hummer), as well as other armament. Retracted (far right), turret is hidden.



TOW MISSILE LAUNCHER





For spy missions, radar boom inside Skyship's envelope (below) can perform surveillance.



The support rigging (above) for Skyship's gondola is of Kevlar cable attached to load curtains.

Airships Rise Again!

They float along ponderously, seeming relics of the past. But airships are making a comeback!

BY MIKE STOWERS

Flying Golfball: The Airship Inspired By PM

It's often described as a flying manta ray carrying a basketball on its back. But maybe giant golfball would be a better word for the experimental heavy-lifter LTA 20-1. One of its designers, Frederick D. Ferguson, says the 20-foot-high airship was inspired in part by a PM article on the aerodynamics of a golfball (see *Golf's Secret Weapons*, page 78, Dec. '78). The craft's balloon, currently being scaled up to a diameter of 160 feet by Van Dusen Commercial Development of Canada, gets lift in three ways: from helium, from rotating fan engines and from the Magnus effect. To take advantage of the Magnus effect, the LTA 20-1 rotates on pins that connect the balloon to the tips of the manta ray's wings. A boundary layer of air forms around the smooth balloon, giving the whole craft enormous lift.—D.E.





Skyship 500, now in service over London, flies at 10,000 feet with a 12-man crew and two-ton load.

On a chilly day last fall, a British Royal Air Force squadron went into alert status to investigate a flying object visible for miles with the naked eye, but which made only a very faint blip on radar screens. The massive object chugged along beneath the cloud cover, gliding right into the approach pattern generally used by the Royal family returning to London from trips to Balmoral Castle in Scotland. To the surprise—and relief—of just about everyone, the UFO turned out to be a friendly dirigible—an Airship 500 making a test run for Airship Industries.

"There's no metal in the structure," explains Reg Hillsdon, Airship's North American representative. "It's all plastics and composites. They stay well-hidden from radar."

Silent running is just one major feature bringing airships back on the scene. Various design configurations make helium-filled vessels front-runners for some futuristic assignments. Hauling lumber or other heavy loads, even taking the place of military spy satellites at less than one-hundredth the cost are among the possibilities. In the very near future, airships are expected to carry passengers around the 2,000 islands off Greece. There are airports on only a few of the islands so airships, which can land on very small and rough fields, will be competitive with airplanes. Airship Industries has sold three vessels to an Aegean touring company.

Airships have been out of the luxury passenger business for the most part since the German rigid vessel *Hindenburg* crashed in flames in Lakehurst, N.J., 46 years ago next month, killing 21 people. That tragedy and several military accidents helped end the much-heralded flying machines' popularity.

But the ships plying the skies today are far safer than even the safest airships of the past. (Incidentally, air-



Goodyear, whose famous blimps are the only airships that are currently operating in the United States, has prepared this concept for a heavy-lifter.

Airships Rise Again!

ships had almost three accident-free decades at the turn of the century, but this fact is overshadowed by a few spectacular accidents.)

The new vehicles are filled with non-combustible helium instead of volatile hydrogen. And latest-generation plastics give the new airships the structural toughness of old-time rigid ships with the lightness of nonrigid vessels. The Skyship 500 in the middle of last fall's royal scramble carried two tons of load and a crew of 12 in its gondola. It moved around almost noiselessly, powered by two 200-hp Porsche engines at speeds up to 60 knots, and soared above 10,000 feet with a full load.

In a Toronto hangar, an Airship team is in the midst of assembling a Skyship 500 for testing later this year by the U.S. Navy. The dirigible will take about one week to meander along the Atlantic coast to Weeksville, N.C., where Navy pilots will be trained to fly it. Then the Navy plans to test the vessel as a radar platform, a sonobuoy-dragger for submarine hunting and a fleet escort vessel.

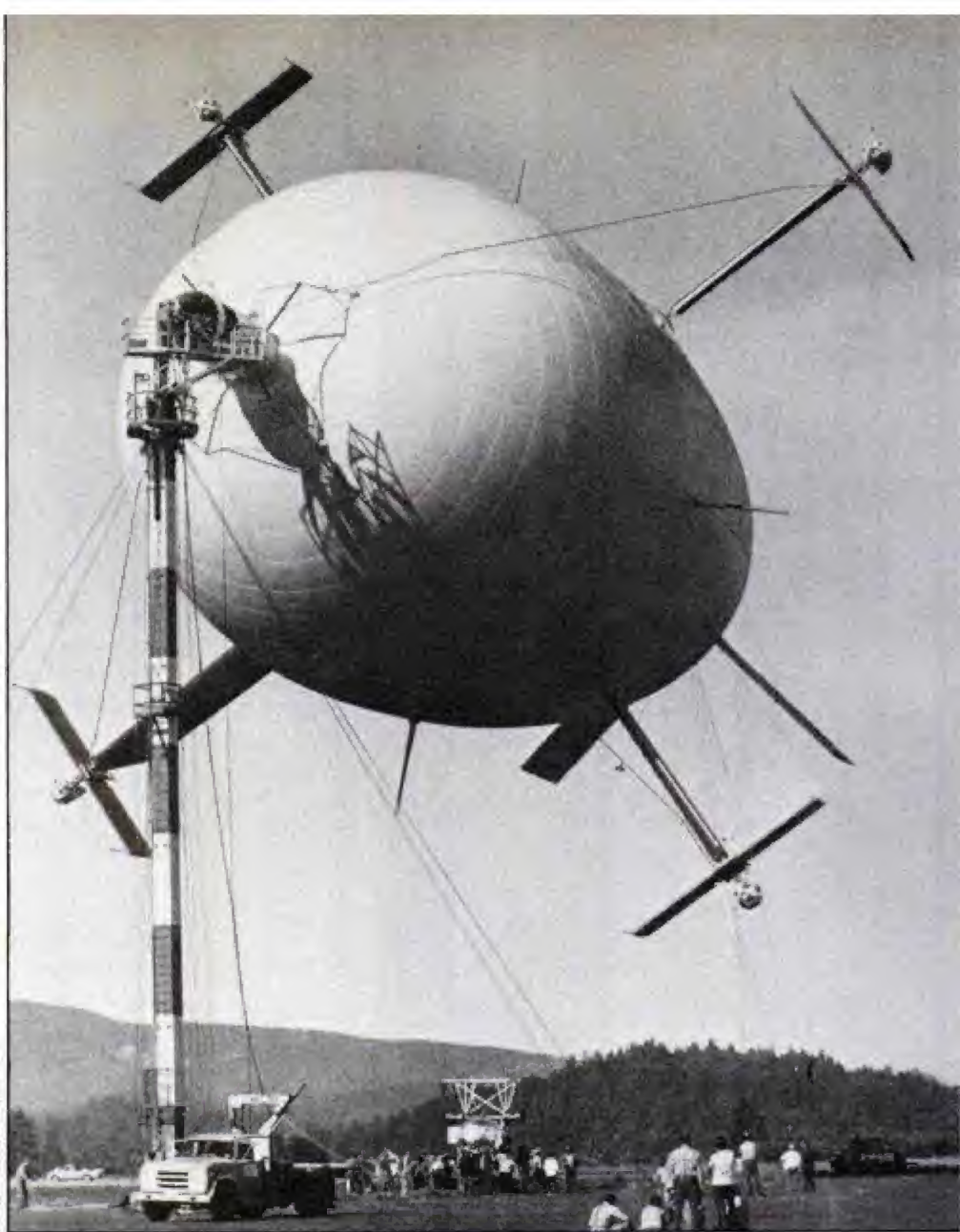
Even while the Navy puts the skyship through its paces, the Forest Service



The large hangar space required by airships, such as those built for the Goodyear blimps (above) have discouraged potential airship users. Still, the airships are excellent candidates for flying radar platforms. Goodyear has added experimental radar to the *Enterprise* (right).



PM photo: Hal Denison



The Cyclo-Crane (above), its helicopter engines operating, and its nose cockpit instrumented, was flight-ready shortly before a storm dashed it against its moorings.

will be testing engines for a heavy-lifter called the Heli-Stat (photos on facing page) being developed by Piasecki Aircraft Corp. at Lakehurst. The lifter, still under construction at press time, is similar to one that crashed in a freak accident two days before its first scheduled test flight in Oregon last year. It also resembles a lifter still on the drawing boards at Goodyear Aerospace.

All of the lifters place helicopters or helicopter-like rotors at four corners of

a light frame that hangs under the airship. The propellers give the airship extra lift and greater ground speed as they haul tons of lumber or other heavy cargo. Goodyear's concept would use a 2.5-million-cu.-ft. nonrigid airship as its basic lifter. The Piasecki craft under construction uses 1.1 million cu. ft. of helium to lift a maximum 37 tons.

Lifter destroyed

So far, the only heavy lifter ever completed was destroyed in a storm at its moorings in Tillamook, Ore. "The crew went home for the night and a storm blew up," says Hal Denison, who has photographed the Aero Lift Co.'s vehicle extensively. "When they arrived at the mooring site in the morning, the Cyclo-Crane was dashing itself against its own moorings. Apparently, it was pulled loose from a tether in a high gust."

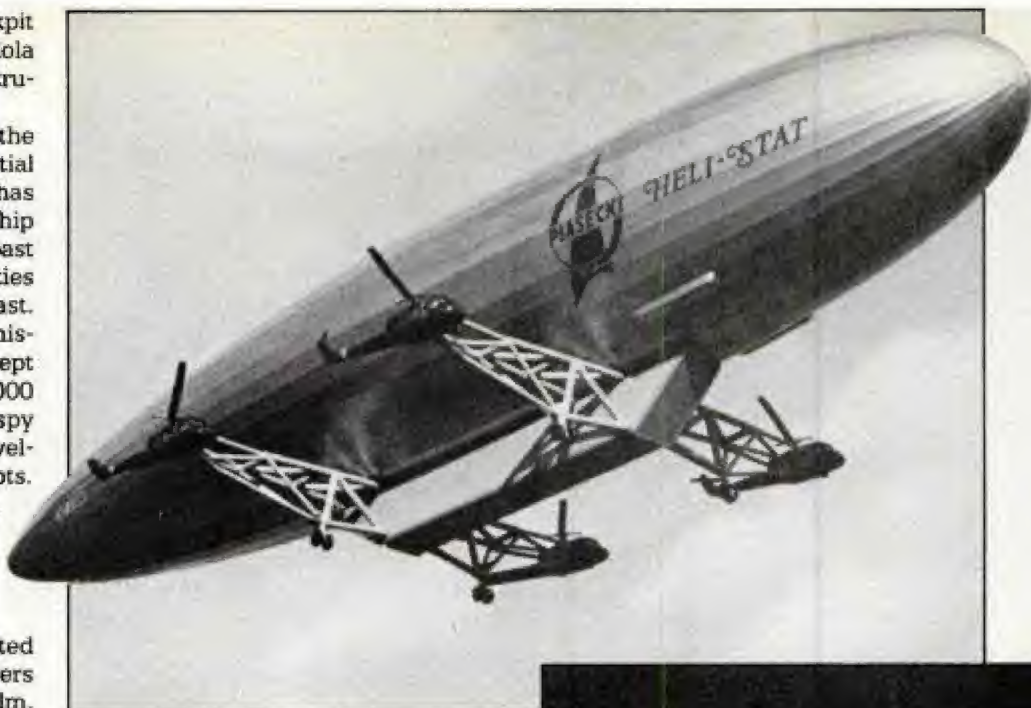
Aero Lift, working with an \$850,000 U.S. Forest Service contract, is rebuilding the heavy lifter and will start tests

later this year. The lifter has a cockpit in its nose and can carry a gondola beneath the airship for more instrumentation or additional crew.

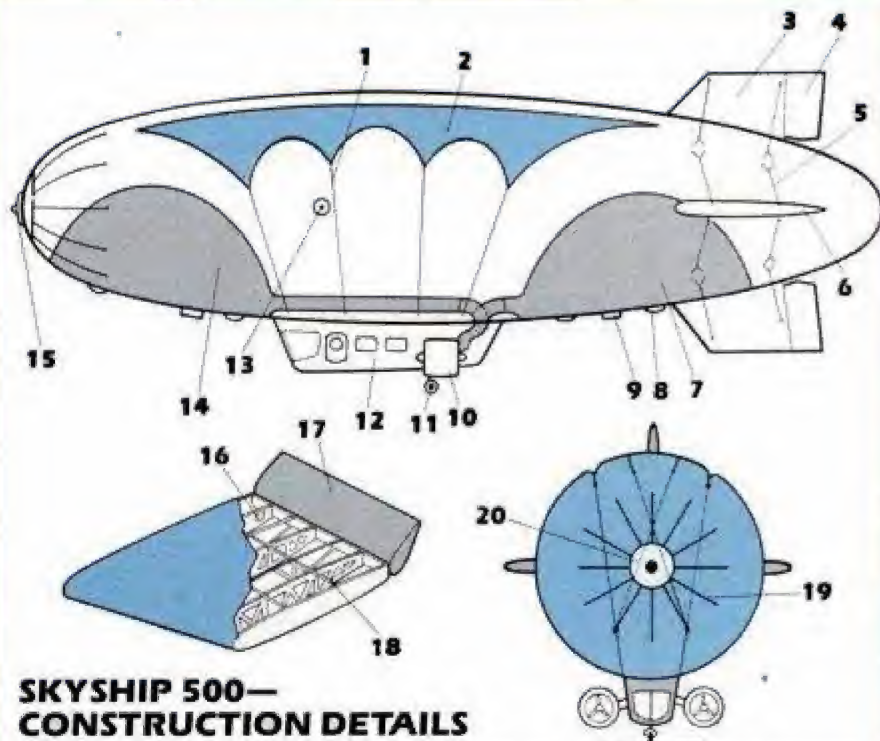
Other airship experiments in the works center on the vessel's potential as a radar platform. Goodyear has mounted a radar system on the airship *Enterprise*, demonstrating to the Coast Guard its maritime control capabilities in flights over the South Florida coast. The Navy, which last year commissioned Lockheed to develop a concept for an airship that can hover at 70,000 feet to perform the same tasks as a spy satellite, has also asked airship developers to come up with radar concepts.

On several certification flights, the Skyship 500 has been equipped with a radar boom mounted inside the main airbag which tested out successfully.

The Skyship envelope is laminated polyester sandwiched between layers of polyurethane and gas-retention film. The envelope fabric was designed for Airship by a French chemical company. Inside the envelope are two large bags that can be filled with air scooped in through lightweight pipes running to the outside of the skyship. These air bags—called ballonets—are made of Polyamide 66 woven fabric and coated with polyurethane spray. In flight, the ballonets have a maximum air capacity



A model of Piasecki's heavy lifter (above) shows the four helicopters adding to the airship's lift and speed. The airship undercarriage (right) has been completed and the first chopper (below right) was mounted late last year.



SKYSHIP 500— CONSTRUCTION DETAILS

- | | | |
|------------------------------|-------------------------|-------------------------------------|
| 1. Kevlar gondola cables (8) | 8. Ballonet air valve | 15. Nose probe for tether |
| 2. Gondola support curtain | 9. Air blower | 16. Nomex ribs |
| 3. Tail fins (4) | 10. Engines (2) | 17. Nomex rudder |
| 4. Plastic rudders (2) | 11. Landing gear | 18. Nomex spar |
| 5. Wire bracing for tail fin | 12. Kevlar gondola | 19. Nose battens (externally laced) |
| 6. Plastic elevators (2) | 13. Emergency air valve | 20. Molded nose cone |
| 7. Aft ballonet | 14. Forward ballonet | |

of about 40,000 cu. ft. each. They must be kept in balance—there's a ballonet fore and aft of the ship's gondola—to minimize surge, the sudden turning of the ship's nose sharply up or down. Also helping to keep the ship's flight stable are six 20-inch valves, two in each ballonet and two in the midst of the envelope.

Ride like a submarine

Flying an airship has often been compared to running a submarine. The ship has to be kept as close to perfectly stable as possible or it will go into a killing dive. Of course, pilots who have flown the Skyship 500 think of it in gentler, more romantic terms.

"Flying a nonrigid is similar to operating a light aircraft," says Nick Bennett, chief test pilot for Airship. "You just need to know Boyle's law (stating that gases expand with heat and

(Please turn to page 190)



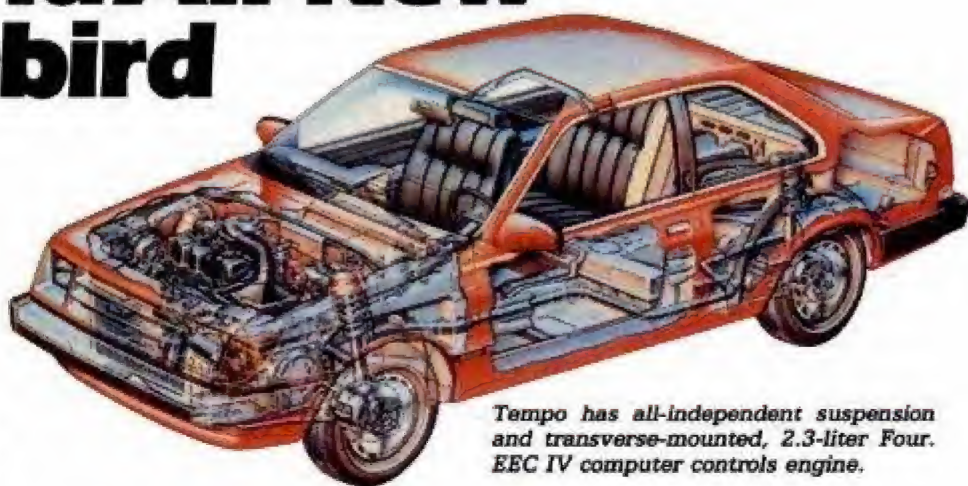
Driving The Ford Tempo, Topaz And All-New Thunderbird

These '83s are more of the right stuff from Ford.

BY GARY WITZENBURG
DETROIT EDITOR

A few months ago Ford introduced its stunning new Thunderbird and Cougar, downsized STD and Marquis family cars, and vastly improved Escorts and Lynxes. Now, it's time for the all-new, front-wheel-drive Tempo and Topaz compacts, a very impressive Turbo Coupe T-Bird and the Ranger-based Bronco II.

This is the second wave of exciting new '83 vehicles designed, engineered and developed under the "new" Ford regime of Board chairman Philip Caldwell and president Donald Petersen. There's not a turkey in the bunch.



Tempo has all-independent suspension and transverse-mounted, 2.3-liter Four. EEC IV computer controls engine.

The first thing you'll notice about the 99.9-in.-wheelbase Tempo and Topaz is their exceptionally clean, uncluttered, aerodynamic styling. These cars spent more than 450 hours getting their corners smoothed in wind tunnels, and they show it.

Doors are "aircraft-style," wrapping up into the roof (over concealed water drain troughs), and both windshield and rear window are sloped at a slip-

pery 60° from the vertical. With drag coefficients of .36 for the two-door and .37 for the four-door, they're slicker than GM's competitive J-car sedans and make the GM Xs and Chrysler Ks look like shoeboxes by comparison.

Ford Div.'s Tempo sedan is distinguished by its three-window profile, while Mercury's Topaz sports a Mercedes-like two-window design. These



Powered by a turbocharged, fuel-injected, 145-hp Four, T-bird is unlike its predecessors. Five-speed manual and 205 Goodyear Eagles make it more of a Euro-sedan than a traditional cruiser.

will compete with Toyota's Corona, Nissan's Stanza, Honda's Accord and Mazda's new 626 as well as the domestics noted above. The fairly rakish coupes, looking much like baby T-Birds, are intended to take on the likes of Toyota's Celica, Nissan's Datsun 200-SX, Honda's Prelude and GM's J-car hatchbacks, among others. Divisional identity is provided by different bum-

per, parking lamp and grille designs (the Tempo has body-color horizontal bars) in front and specific rear panel and taillamp themes in back.

The Tempo/Topaz interiors are nearly as tasteful and restrained as the bodies are smooth. The instrument panels are not quite European in character (stick-on wood grain still prevails in upmarket models) but a long way from

"Yankee flash" gaudy. An optional gauge package provides fuel and temperature dials between the large, circular speedometer and a matching tachometer, but the oil-pressure gauge and ammeter are console-mounted below the radio. Base cars have handy door bins and a small storage box above the radio, while higher-series models

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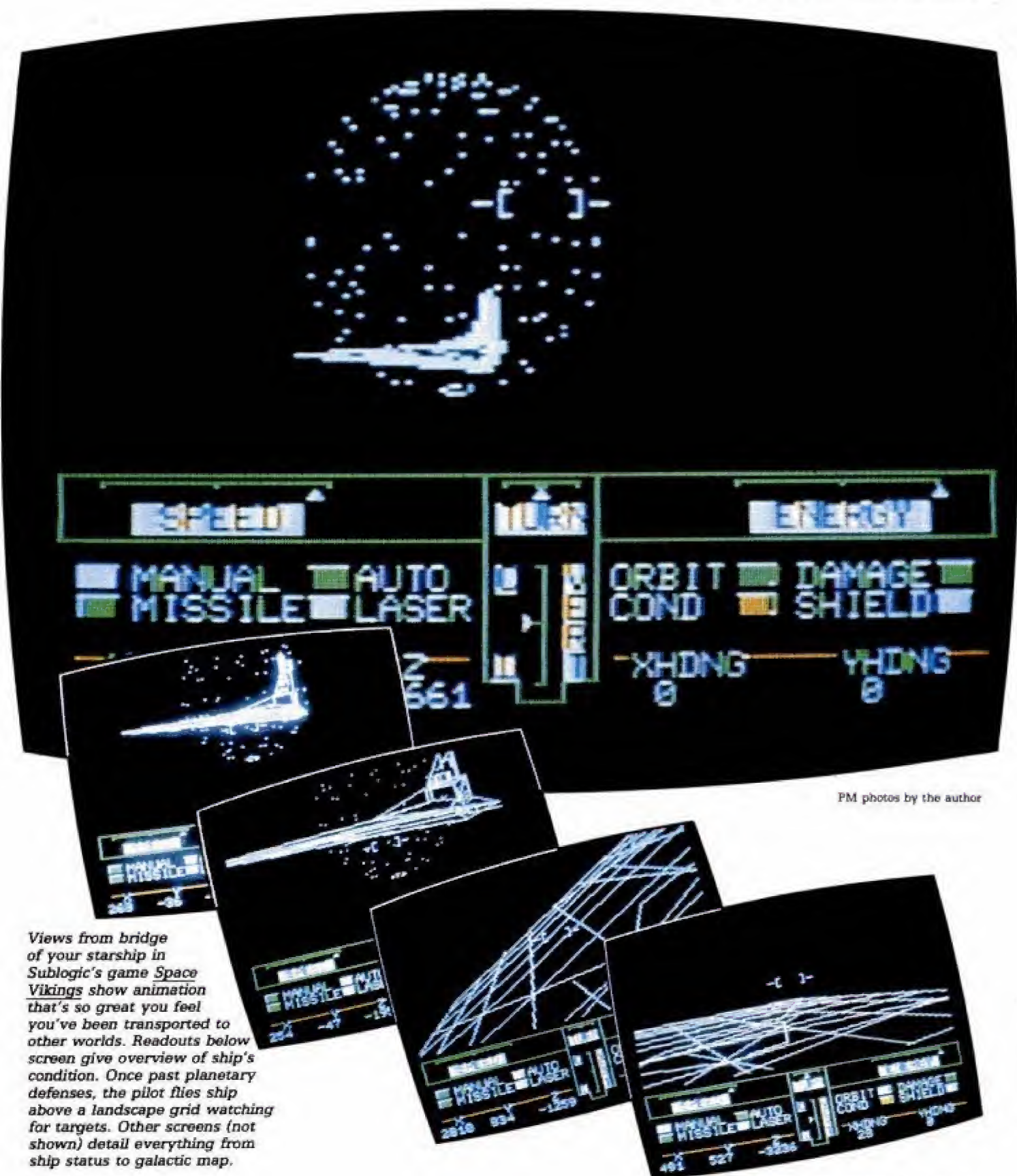


Part of Tempo's uncluttered, aerodynamic styling includes doors which wrap up into the roof. Tempo's Cd is a low .37.

New Video Games

Now these video adventures offer three-dimensional, animated scenes of challenge and excitement.

BY NEIL SHAPIRO ELECTRONICS EDITOR



PM photos by the author

Views from bridge of your starship in Sublogic's game *Space Vikings* show animation that's so great you feel you've been transported to other worlds. Readouts below screen give overview of ship's condition. Once past planetary defenses, the pilot flies ship above a landscape grid watching for targets. Other screens (not shown) detail everything from ship status to galactic map.

Put You In The Action

New games that flash their excitement through scene after shifting scene are cropping up everywhere that there's a video screen to view them on.

A typical video game used to feature a static scene in the background; only the "players" would move. Aliens would shift back and forth above your missile-firing gun—but the animation was confined to gun and targets. Now, things have changed into a complete orchestration of animation with set-

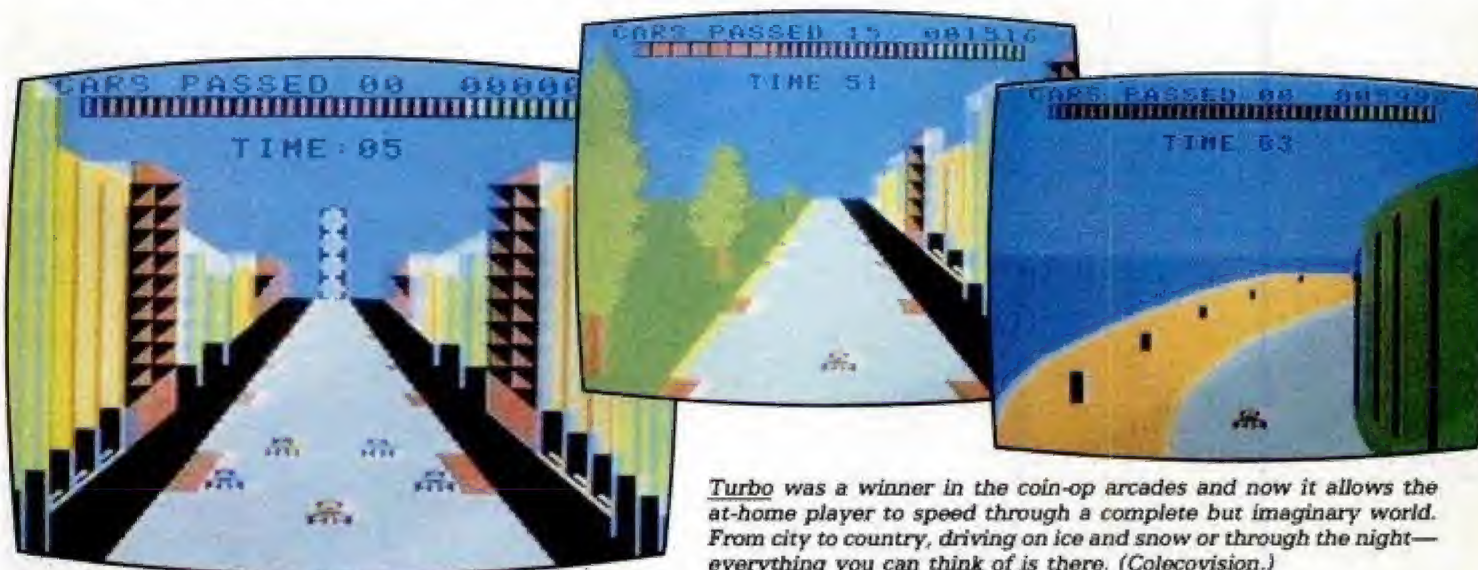
with a real feeling of "being there."

The next stage of simulating reality comes with the *Turbo* game (also arcade and Colecovision). In this one, you're seeing a completely 3-D view of the scenery rushing at you, much as you might see from the windshield of a real, speeding racer.

Already, games such as these are a far cry from static backgrounds and repetitive play. But the next stage of video play is now showing up in home computers and will probably be finding

ples of this new philosophy of total gaming involvement in as complete an environment as possible. They foreshadow what we think will be the next big wave in video gaming.

In *Space Vikings* the player is in complete control of a starship. The displays that he sees on screen seem to us very similar to the displays that a real starship commander might be watching. The animation is superb as you pilot your starship closer to the enemy planet. Meanwhile, you keep track of every-



Turbo was a winner in the coin-op arcades and now it allows the at-home player to speed through a complete but imaginary world. From city to country, driving on ice and snow or through the night—everything you can think of is there. (Colecovision.)



Ultima II from Sierra Online is incredibly detailed. Movement on the main map of the world (left) can take you into castles (center), dungeons (right) and literally hundreds of other places on a quest through both Time and Space. (Apple II.)

ting—the latest games resemble stage plays with complete scenery changes.

In some, such as *Zaxxon* (available both in the coin-op arcades as well as a home version for the Colecovision game) the scenery scrolls by "below" you as you fly three-dimensionally above the video landscape. These scrolling-landscape games provide you

its way into the video game cartridges soon. These new games are so complex, so detailed and so incredibly real that they boggle the imagination.

Detail upon detail

Space Vikings from Sublogic and *Ultima II* from Sierra OnLine (both for the Apple II computer) are prime exam-

thing ranging from damage control to your crew's morale via many different auxiliary screens of computer readout. The bottom line is that the game features just about as much real-life feedback as you could get without feeling the actual vibrations of the engines.

Other games, such as *Ultima II*, do
(Please turn to page 186)

PM OWNERS REPORT:

BY MICHAEL LAMM WEST COAST EDITOR

DODGE CHARGER

*"Eliminate the back seat.
It's useless."*

MINNESOTA MANAGER

"A whole lot of fun to drive under any conditions."

MAINE GROCERY DISTRIBUTOR

*"Sharp-looking, very fast for a Four,
good gas mileage."*

MICHIGAN REPAIRMAN

**"SOMETIMES HAVE TO
FORCE TRANSMISSION
INTO FIRST OR REVERSE."**

MAINE TELEPHONE OPERATOR



It's fast, fun and economical, and owners love their nickel rocket.

"A good-looking, have-your-cake-and-eat-it sporty car," exclaimed a young Michigan design engineer, "with very impressive acceleration and equally impressive fuel mileage. Where else can you find a front-wheel-drive car that's made in America, is cheaper than the competition, and has a five-year, 50,000-mile warranty?"

That paragraph pretty much sums up what most owners like about the 1982/



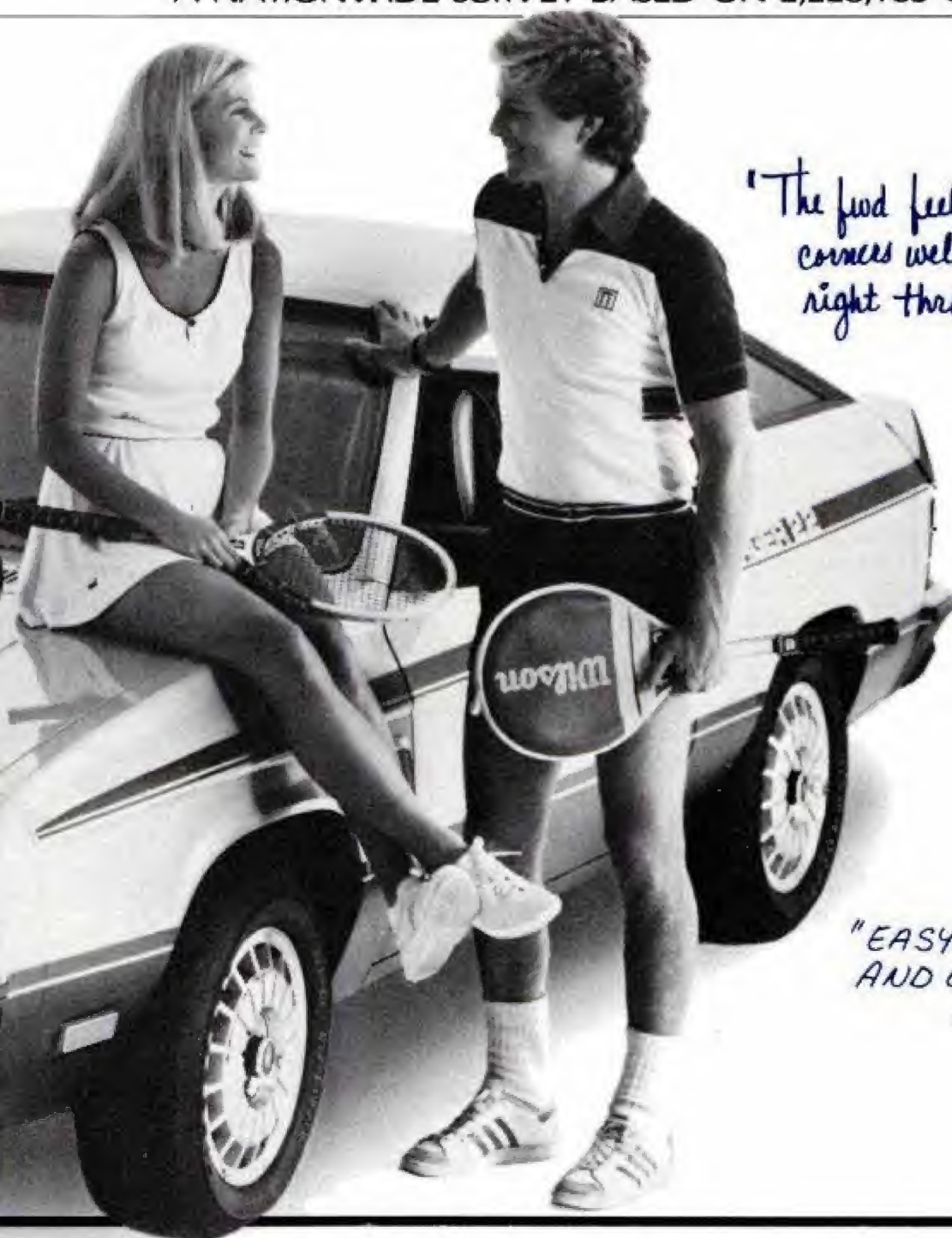
The cockpit, with its dished four-spoke wheel, matches the car's sporty looks.

83 Dodge Charger. Not only were about 72 percent of the buyers we surveyed attracted by the car's looks, but

53 percent praised its economy, and 24.2 percent commented very favorably on the Charger's strong acceleration. That's an unusual combination—sporty looks plus mpg plus performance. It's not often that all three come together in the same automobile.

Basically, the Charger coupe uses the mechanicals and body platform of Chrysler's Omni and Horizon sedans. For 1982, Dodge offered a base model, called the 024 Miser. Above that came the Custom 024. Both used the Volkswagen-built 1.7-liter overhead-cam Four.

Last year's Charger 2.2 marked the hot ponycar of the line and carried Chrysler's own 2.2-liter ohc engine. It's



*"The fwd feels stable on the road,
corners well, plows
right through the snow."*

MONTANA DAIRYMAN

*"EASY ACCESS TO PLUGS
AND OIL FILTER."*

OHIO INSURANCE SALESMAN

PM photos: Bill Ashe

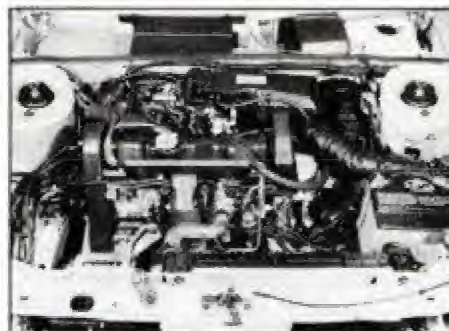
this powerplant that gives Chargers their snap. This year, the 024 name has been dropped and all versions are called Charger.

There's the base 1983 Charger, with a Peugeot-built 1.6 engine, plus the Charger 2.2 and the Shelby Charger. Chrysler now offers a five-speed trans-axle and has upped the 2.2's horsepower from 84 to 94, with 107 in the Shelby.

A West Virginia salesperson: "It's a very peppy car, and I love the way it handles. It's comfortable and easy to drive, with a good factory stereo system and a convenient hatchback."

Throughout their comments, many owners emphasized basic, simple val-

ue. No one accused the Charger of being the world's greatest car, but purchasers continually compared this cou-



Owners love the Chrysler-built 2.2-liter Four, which combines power, economy,

pe with its competition, and the Charger mostly won.

For example, a Colorado engineer added, "I carefully weighed performance, style and economy against price. When analyzed in a studied way, no other car comes close to the Charger 2.2 in terms of value, including the VW Scirocco, Honda Prelude, Ford EXP, Mercury LN7, Toyota Celica and Renault Fuego."

A Tennessee book layout apprentice echoed, "I tested a number of cars before selecting the Charger. First, I took out a new Camaro Z-28, which listed for \$12,530. Next, I drove a new Capri RS with the 302 V8. That one had

[\(Please turn to page 192\)](#)

PUT YOUR OWN PROJECT ON THE

If PM picks your experiment to go on the Space Shuttle, you'll fly to Florida free to see it launched!

BY DENNIS ESKOW SCIENCE EDITOR

If there's any pioneering spirit in you, hang onto your seat—you're about to get invited aboard the Space Shuttle. Think of it as "T-minus three months and counting." PM has purchased space in the cargo bay of the Shuttle, and we're inviting you to think up an experiment to send into orbit. The winner of this competition and a friend or relative will be flown free to Florida to watch the launching, then on to Houston to join ground control in monitoring the Shuttle mission, and finally to California or Florida to watch the Shuttle touch down.

We're the first magazine in our field to join NASA's Getaway Special (GAS) program, but we probably won't be the last. At this writing, more than 400 universities, corporations, private individuals and one Japanese newspaper have purchased the right to fly an experiment. We have ticket No. 68, which means your experiment could be launched within a year after we start putting it together.

Your travels to the launch, mission control and landing will be sponsored by the Bushnell Div. of Bausch & Lomb. The winner also will receive Bushnell's Criterion 4000 telescope, an outstanding reflector scope. The runner-up will win a Celestron C-90 spotter scope, a compact telescope well suited for plane-



COMPETITION RULES

Phase 1

1. Entries should be typewritten or block-printed on a single sheet of white paper. Your name and full address should be centered at the top of the page.

2. Experiments should fit inside a 2.5-cu.-ft. canister and weigh less than 60 pounds.

3. Any experiment involving plant or animal life should explain how life would be sustained, since we're traveling in the airless cargo bay.

4. No project involving lithium batteries will be accepted. NASA won't allow them on the shuttle. Small, commercial-quality NiCd packs and off-the-shelf batteries for microprocessor systems are the best.

5. Materials should be able to withstand temperatures up to 200° F. and gravitational forces of 4 g—four times the gravity of earth. They also should be able to handle noise levels of 145 decibels. Vertical acceleration of

4 g, forward acceleration of 1.8 g and lateral acceleration of 1.2 g may occur at the same time with some Space Shuttle maneuvers.

6. Some structural plastics and composites may outgas and deteriorate in a vacuum. The idea you submit should take this into account.

7. On touchdown, cargo bay temperatures could rise to 180° F. Forced air circulated around the bay at about room temperature should keep it cool, but some provision should be made for sudden temperature variations.

8. Your experiment will be kept in storage a maximum three months before and a minimum three weeks after launch at room temperature and prevailing moisture conditions.

9. Experiments involving possible dangerous substances—such as explosives, or possibly dangerous configurations, such as gas containers—should pro-



VALUABLE PRIZES

Win PM's Space Shuttle competition and you'll get an expense-paid trip for two to Cape Canaveral for the launch. Then you'll fly to Mission Control in Houston and, finally, go on to either Florida or California for the landing. You'll also win a Bushnell Criterion 4000 telescope (far left). It's a twin to the Dynamax, which we praised last year (see *Back-Yard Voyage To The Stars*, page 86, June '82). Runner-up wins a Celestron C-90, also highly rated last June.

SPACE SHUTTLE!

Winner's experimental apparatus will be sent into orbit in this 2.5-cu.-ft. canister.

3-D CAMERA

SOLAR BALLOON

PM's canister will be loaded on a cargo bay pallet (left). Possible experiments could use solar balloon, 3-D camera.

vide for safety to the vessel and bay area. Most shuttle systems require a safety factor greater than one, meaning you must provide for basic safety with backups to reduce the chances for failure.

10. All proposals for multiple experiments should include proposals for monitoring the experiments. Telemetry, or any equipment that beams a radio signal to earth, is generally not permitted in the cargo bay area. Multiple experiments may be turned on and off by conditions in the bay area, such as sudden gravitational shifts or sudden changes in temperature.

Regardless of the number of experiments we carry, the astronauts will be permitted to throw our command switch only twice. That is why all experiments have to feed off the common switches.

11. All entries become the property of Popular Mechanics, which reserves the right to print all or part of the entry and the author's name. Devices designed for this mission may be patented by PM or one of the participating institutions with PM's permission.

12. All entries must be postmarked by midnight, July 30, 1983. Only winners will be notified. No entries will be returned. Sorry, but the volume of mail may prohibit us from answering inquiries.

Phase 2

The top 25 entries from Phase 1 will be entered into the second phase of the contest automatically. Finalists will be notified in late August and receive more detailed information on the experimental conditions. Each finalist must then write an expanded version of his proposal—to a maximum of 10 pages, including illustrations. The final proposals must be submitted to PM postmarked no later than midnight, Dec. 1, 1983.

If there's room in our canister, PM may send the second-prize entry aloft with the winner. In addition, the experimental apparatus may differ from the submitted proposal. PM reserves the right to construct the final version under its direct supervision.

tary or lunar observations. More prizes will be announced in coming months.

Thinking up experiments to put on the Space Shuttle is exciting and mind-expanding. We've already toyed with a few concepts to help you organize your own thoughts. *Shuttle Program Debut Was A Real 'GAS'* (see story below) describes one project

launched in a container similar to ours last year.

The story's author, Herbert Fox, is vice president for engineering and research at New York Institute of Technology, which will build PM's experimental apparatus as suggested by the winning reader. Other institutions will be working with us on specific areas of design of the final experiment.

We'll be reporting on their work in future issues.

Whatever the experiment, it must fit inside a 2.5-cu.-ft. canister, and must weigh 60 pounds or less. Our rules (see page 102) spell out the major constraints and possibilities, but consider some of the proposals we've already dreamed up to help you visu-

(Please turn to page 191)

SHUTTLE PROJECT

Shuttle Program Debut Was A Real 'GAS'

Hard work and perseverance by a team of Utah State University students helped send the first Getaway Special (GAS) project into orbit aboard the Space Shuttle last June. The 5-cu.-ft. canister—19.75 inches in diameter and 28.25 inches high—was donated to the Utah students by Gilbert Moore, an executive of Thiokol Corp., which makes the solid-fuel boosters that carry the Shuttle into orbit. The canister carried a total of 200 pounds. (PM has purchased a smaller canister space of 2.5 cu. ft. and 60 pounds.)

The students rigged up the canister to carry nine experiments, including one on the effects of low gravity on soldered joints, which I investigated at length. Other experiments included development of test hardware for conducting automatic analysis of green algae growth in orbit, the calculation of heat-conducting abilities of an oil-water mixture, and the study of the effects of low gravity on metal alloys.

The Utah Payload Actuation and Control System (PACS) monitored and controlled the multiple experiments with a 2 million-bit, low-power (100-megawatt) digital recorder.

The microgravity soldering experiment used PACS to control four separate heating and temperature-monitoring systems, with each melting 24 solder samples. The systems worked off a common (battery) power supply.

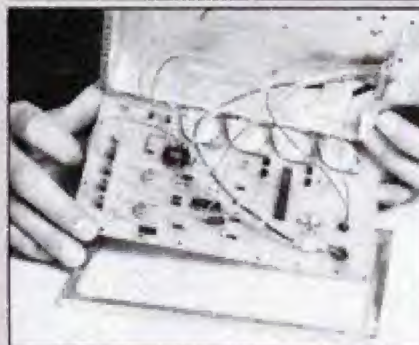
How it works

When the astronauts flipped the bipolar switch in the flight deck, it activated the heaters, which melted the solder samples on a copper foil. Whenever a temperature above 525° F. (oven temperature) was sensed by a device inside

the canister, the heater turned off instantly. If no oven temperature was sensed, the heat shut off 15 seconds after it started.

The heaters were mounted on printed circuit board material. Each was composed of a Kapton-insulated heating foil bonded between a layer of copper foil and a fiberglass insulating layer. The bonding agent employed was a silicon adhesive manufactured by General Electric.

The payload is currently being analyzed for trapped pockets of flux, and the solder points are being compared to those similarly created on earth. The experiment may prove useful in any future GAS projects which call for soldering as an incidental, but important, part of the mission. —Herbert Fox



The Utah State experiments featured low-gravity soldering kit (above top), which was capable of soldering 24 points at one time. The control circuitry (bottom) could stop the soldering process in seconds.



PM photos: James K. Huffaker

A Utah State team member works on the circuits which operate the payload control system. The testing equipment placed on top of the 5-cu.-ft. canister helped team in preflight trouble-shooting.

Mercedes-Benz 190, the European-market model which we drove in Spain, will arrive here in the fall with a different engine, designated as the 1984 220E.



Driving The Mercedes 190 And BMW 318i

When you're talking *blitzwagens*, smaller never means cheaper.

You know you're in a Mercedes. It feels like every other Mercedes-Benz automobile you've ever driven. The engineers have seen to that. Same solid, weighty feel. Same road-flattening, press-on-regardless stability that you've experienced in a dozen other Mercedes models. Even the same steering wheel and general interior layout. But this one's different. Very different.

First of all, it's quick. In fact, it's one of the quickest you've driven in a long time. On a deserted road out here in the hinterlands of Spain, where you've come to be part of the worldwide press introduction of this car, you've racked up several 0-to-60-mph times of just over 10 seconds. One run seemed like a 10 flat. Yes, other Mercedes-Benz cars are great, once you're on a roll. But off the line, they are quite lethargic. This one's different. Rev it up, dump the clutch and you're gone. You can get rubber going into second, too, if you shift quickly enough and declutch at precisely the right instant.

Declutch? A clutch? In a Mercedes?

Yes. Remember, this one's different. Up to now, the only Mercedes you've ever seen with a clutch was a lowly 240D with its tractor-like performance. And you've done your darndest to stay away from them. But now, here's a Mercedes-Benz with a clutch and a stick shift, a five-speed if you like, and all the performance of, well, yes, let's say it, a sports sedan from BMW.

Say that around a Mercedes-Benz public relations man and he'll tell you that his company has no intention of competing with BMW, in car concept or in price. In price, he's right. By the time this new, small Mercedes-Benz 190 (it'll be called the 220E in the United States) hits American shores, the price will be a staggering \$24,000.

In concept, though, the comparisons will be inevitable. This new Mercedes-Benz is sized right near a BMW 318i, and the 318i and its predecessor, the 320i, has long been a benchmark of performance for small, two-liter, sporty sedans in this country.

The engineers have told you that the 1,997-

cc, overhead-cam, four-cylinder engine you've experienced in both carbureted and fuel-injected versions here will not be available in the U.S. model. Instead, we'll be getting a fuel-injected version of the 2.3-liter Four formerly used in the old Mercedes 230 models. Later, a diesel engine option will join the lineup. The larger 2.3-liter engine will be used to compensate for the addition of power-robbing emission controls to be installed on the U.S. engine.

If it performs like the European 1.9-liter version, American buyers should be well satisfied with the performance

(Please turn to page 178)



Although it's all new, the 318i looks a lot like the 320.

PM OWNERS REPORT: CHEVROLET CAMARO

BY MICHAEL LAMM WEST COAST EDITOR

*"The styling of a sports car,
good passing performance,
excellent stereo."*

ALABAMA SECRETARY

*"Exhaust system hits body,
creates banging noises."*

OHIO ENGINEER

*"Dealers need to be educated
on the importance
of decent service."*

MASSACHUSETTS PROGRAMMER

"An excellent road car."

CALIFORNIA ANALYST



Looks seduced buyers,
but it's the great handling
that keeps them satisfied.

You don't have to look far to know why people buy new Camaros. Styling tells the story. Chevrolet's Camaro and its cousin, the Pontiac Firebird, have both been bright spots in a lackluster automotive sales year, and there's basically one reason: People like the way GM's ponycars look.

Nearly 90 percent of the 1982-83 Camaro owners we surveyed listed "styling" as their No. 1 reason for purchase. That unsurprising figure is very



Front-seat room and comfort got good grades. Rear seats didn't do so well.

close to the 82.7 percent logged by the new Firebird (see *PM Owners Report: Pontiac Trans Am*, page 150, Jan. '83). To give you some idea of the enthusias-

tic response to the new Camaro's design, here's a sampling of love letters.

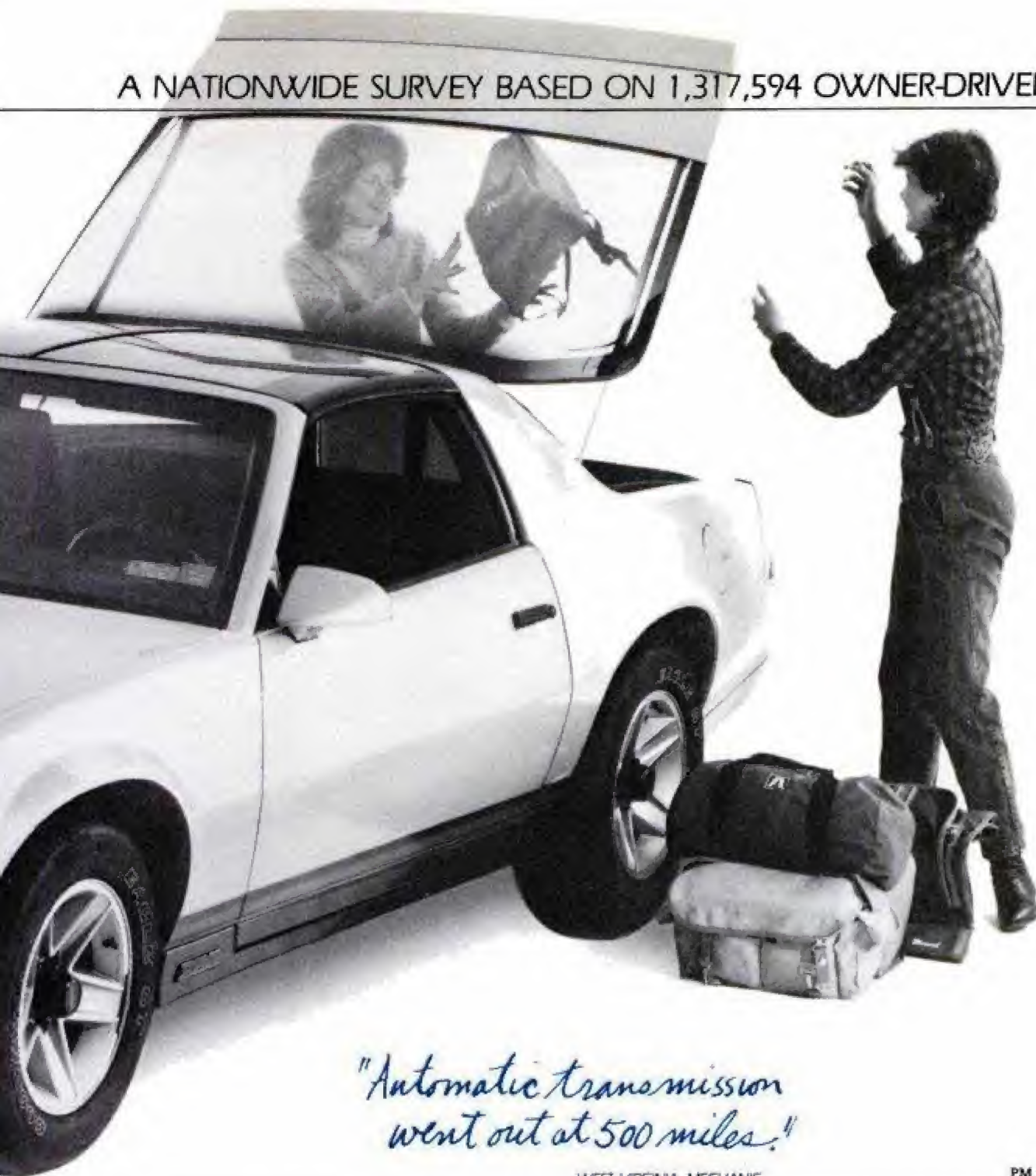
A New Hampshire industrial safety instructor observed, "I like the stares I get from passers-by. My Z-28 serves me as a businessman's sports car."

A North Carolina truck driver: "Best-looking and best-handling car on the road today!"

A Texas lab assistant: "It's a very sharp-looking car. I fell in love with this white-and-gold Z-28 at first sight. Besides, it handles just beautifully!"

Handling ranked right behind styling in our "Specific likes" category, and a Massachusetts U.S. Navy aviator confided, "The Z-28's handling beats the

A NATIONWIDE SURVEY BASED ON 1,317,594 OWNER-DRIVEN MILES



*"Automatic transmission
went out at 500 miles."*

WEST VIRGINIA MECHANIC

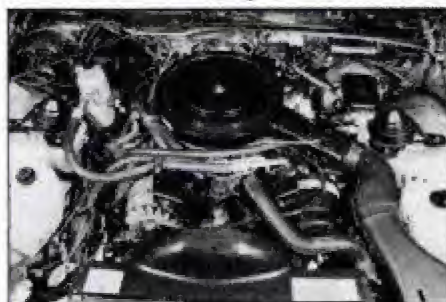
PM photos: Bill Ashe

imports, yet the car costs \$1,000-\$6,000 less. I shopped for over a year, comparing the Z-28 to the Boss Mustang, Mazda RX-7, Celica Supra and Datsun 280-ZX. The Mustang was faster off the line, but not by much. It cost \$2,000 more and didn't touch the Z for handling. And the others were just too expensive. For my money, the Z-28 is the best car on the road."

A Michigan hospital orderly said, "I'm just delighted to own the '82 Camaro Z-28. It handles like my brother's Corvette, but without the harsh ride, and I think it looks better. Construction is very good. Everything fits and looks nice, inside and out. Good attention to detail. After all the talk

about American cars being thrown together, the Camaro is a nice surprise."

In all, 74 percent of our respondents rated workmanship good to excellent.



Most thought V8 provided "decent" power, but some felt it wasn't enough.

That's not a remarkably high figure, but it is four points above the Trans Am and about average for Detroit-built cars.

However, 61.4 percent reported mechanical troubles—mostly of a minor nature. But a 61.4-percent repair rate is considerably higher than most of the cars we report on. The greatest problem area seemed to be the transmission.

"A nut on the shift lever fell off, causing the gears to lock," complained a Maine accountant. Nor was a Massachusetts water worker alone when he pointed out, "The transmission gasket didn't seal due to a burr on the mating

(Please turn to page 181)



Build Our Master Craftsman's Toolbox

This beauty was built by a craftsman to hold his prized tools.
Using PM's exclusive plans, you can build your own.

BY WALTER E. BURTON





Our solid cherry toolbox with brass hardware is handsome enough to grace any living room or den. It's equally at home in the shop for storing fine tools.

Old wood toolboxes originally designed to hold micrometers, gauges and other machinist tools have become valuable items at antique shows. Although similar toolboxes are still manufactured, the design and quality of the old boxes have made them more popular than ever. Nowadays, old machinist toolboxes are used for such purposes as storing camera equipment, hobby collections and jewelry, as well as tools. It's not easy finding an old toolbox in good condition, so build a replica, using our plans.

Many of the antique boxes were made of walnut, oak or other hardwood. We used 1/2-in.-thick cherry from The Woodworkers' Store (see materials list at end of story). The toolbox is finished with a cherry stain and satin varnish. The hardware can be either brass or brass-plated.

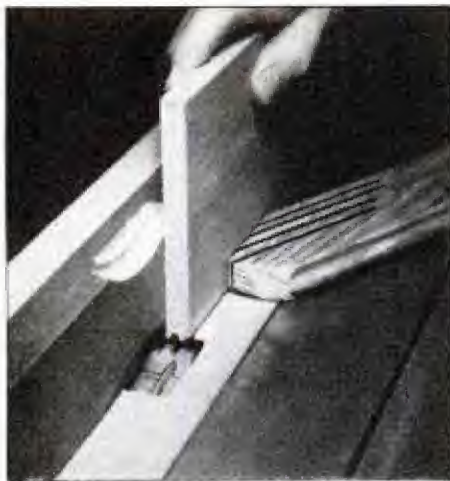
To obtain the full-width panels for the toolbox top, bottom, sides and back, it's necessary to edge-join two 5-in.-wide cherry boards. The edge-joints are cut on a table saw with a molding cutter head fitted with glue-joint cutters. This shape requires just one pass per board to produce mating edges. After shaping all the edges, apply glue to the joints and clamp each panel. After the glue has dried, finish-sand all pieces and cut them to size.

Box joints are used at the lid corners and to join the bottom to the sides. The box joints are cut on a table saw with a 1/4-in.-wide dado head.

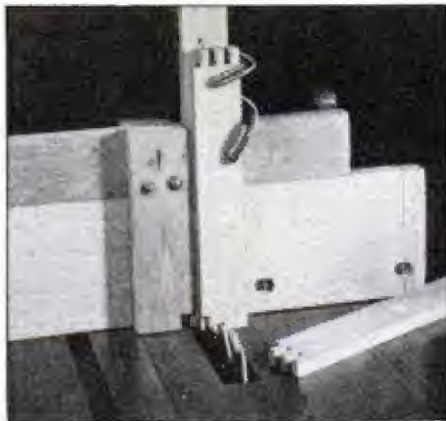
Notice that the back panel receives a 1/8-in.-deep x 1/2-in. wide blind dado (a dado contained within the piece, not plowed to an outside edge). The side pieces receive stopped dados (dados plowed into one edge, but not through to the other). Cut the dados with a router and a 1/2-in. mortising bit. When the box is assembled these dados will hold the top compartment's plywood bottom. Install the partition centered on the underside of the compartment bottom by screwing down into the partition.

Dry-assemble the main box, checking that all joints fit properly. To temporarily hold the box together, screw the upper compartment in place with 1 1/4-in. No. 6 fh screws. Be sure to position the screws so that the brass corner

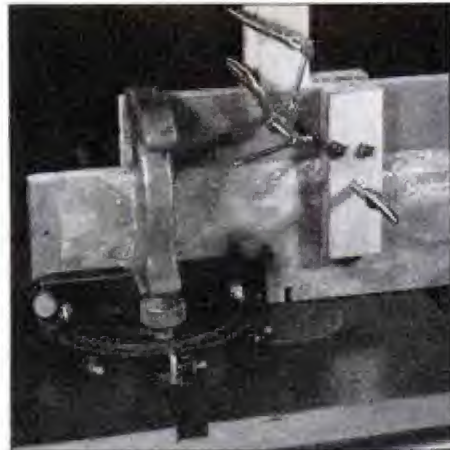
PM photos: Color, George Ratkai; black and white by the author
Construction: Walter E. Burton
Consultant: Peter Johnke
Tools: Garrett Wade, 161 Avenue of the Americas, New York, N.Y. 10013



Cut edge glue-joints with a molding cutter head to form full-width boards.



Homemade jig bolts to saw miter gauge for cutting box joints. The vertical upright properly aligns the workpiece with the 1/4-in.-wide dado head.



Box-joint cutting jig (rear view) has thumbscrew to adjust the vertical fence for each pass over the blade.

angles will cover up the screw heads. With the box temporarily assembled, you can now build the drawers with any necessary adjustments to the box made easily.

The drawer joints are cut on a table saw, but a router with the correct bits could be used, as well. The decorative bead along the top edge of each drawer front is made by routing a shallow V-groove 1/8 in. from the top edge. Hand-sand the rounded bead with 80-grit abrasive paper. The drawer fronts are made of cherry, while the sides and back are pine. Drawer bottoms can be

of sheet aluminum (aluminum siding scraps work fine) or 1/8-in.-thick tempered hardboard. Be sure to plow the necessary dados and rabbets in all the pieces before assembling the drawers.

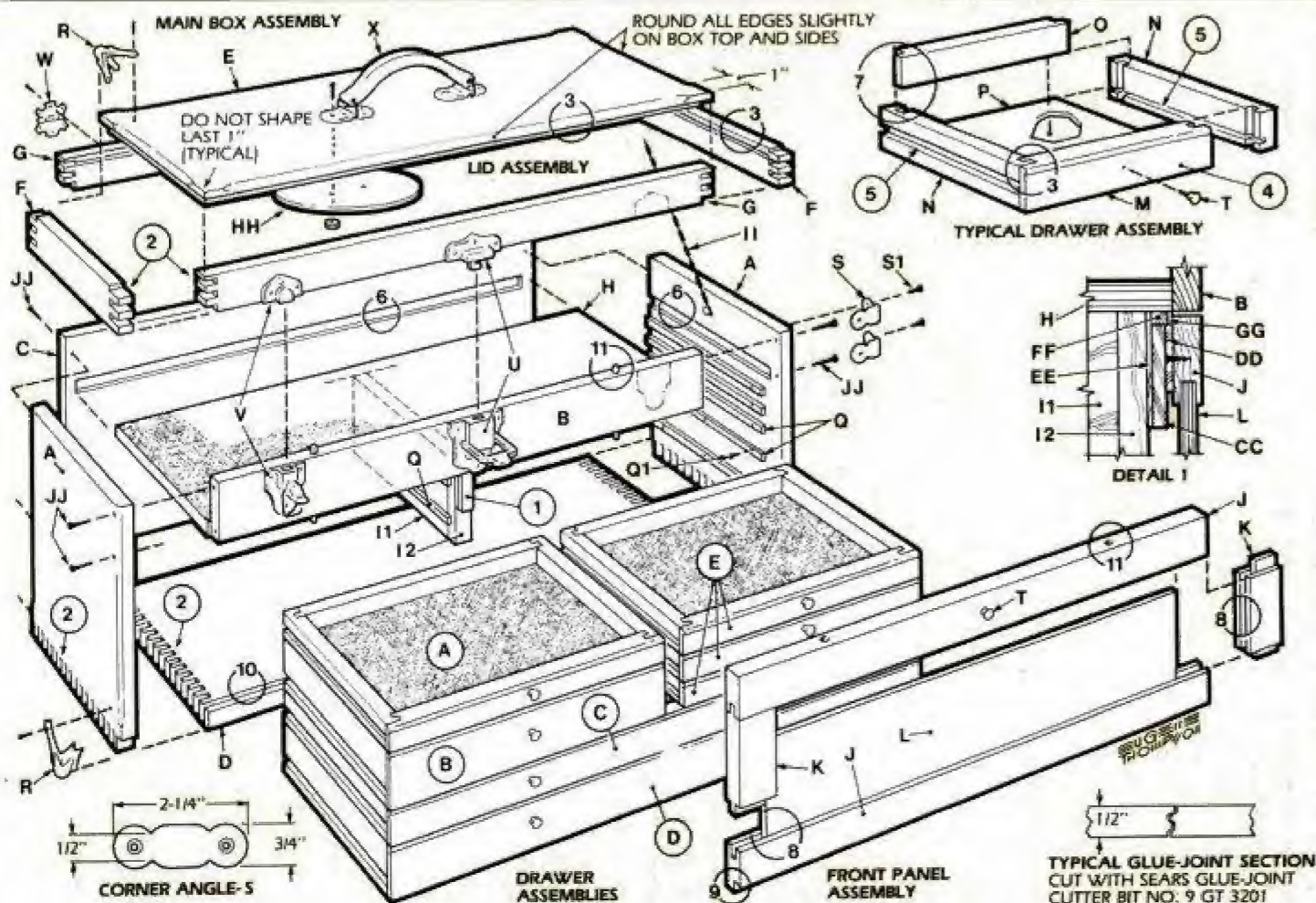
Next, cut the drawer slides from hardwood maple. Temporarily fasten the drawer slides to the box with brads. Install each drawer, making drawer-slide adjustments where necessary. Drawers should have 1/8-in. clearance on both sides. Bore pilot holes and countersink the slides for 1/2-in. No. 2 flathead mounting screws.

Dismantle the box and stain all wood

surfaces that will be visible in the finished toolbox. We used Zar cherry stain-sealer No. 116.

Slow-setting hide glue, which allows time for adjustments, is used in the final assembly. Spread the glue between box-joint pins (fingers) with a small brush. Reassemble the box and clamp square until the glue dries. With the box completed, lid assembly and installation are next.

Dry-assemble the lid to ensure that it matches the box dimensions before gluing and final assembly. Install the lid hardware with the lid clamped to

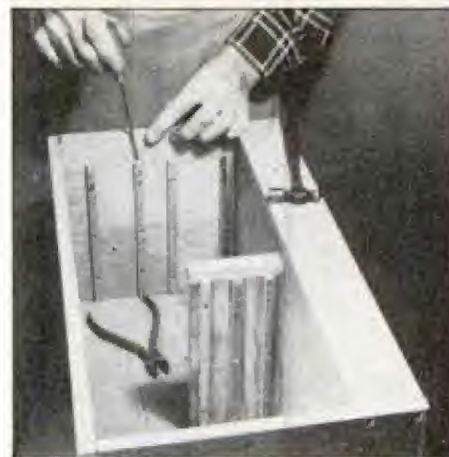




Cutting drawer fronts for rabbet-in-dado joint. Extra block on miter gauge holds the workpiece against the fence and prevents dangerous kickback.



With the drawer front face up, the final cut produces the rabbet which then fits into the drawer side dado.



Tack-nail the drawer slides and test-fit all drawers. Make any necessary adjustments before screwing in slides.

the box for proper hinge and latch alignment.

Toolbox locking pins

When the toolbox lid closes, two spring-loaded pins are pushed down into the front panel's top edge to prevent the panel from being opened. There are two ways to fabricate the pins. One is to machine the pins on a lathe from $\frac{1}{4}$ -in.-dia. steel or brass rod. The second way is to bore a $\frac{1}{8}$ -in.-dia. hole into the end of a $\frac{1}{4}$ -in.-dia. rod, and then drive in a section of $\frac{1}{8}$ -in.-dia. steel rod. Bore a No. 51 (.067-in.-dia.)

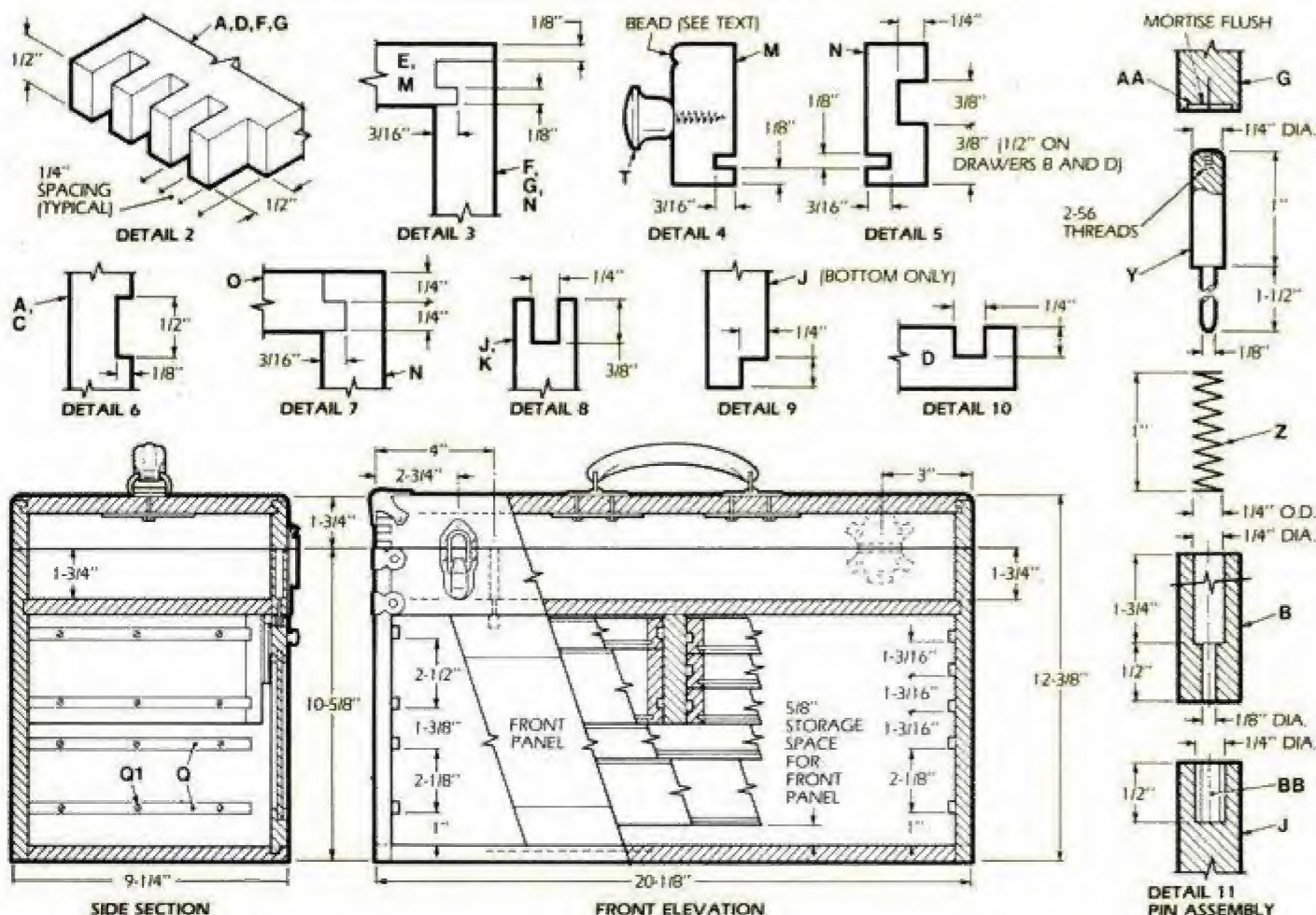
hole in the top of each pin, then tap both holes with 2-56 threads. On the off-chance that a pin should become jammed, insert a 2-56 bolt to pull the pin free.

To install the pins, first find the pin locations on the box front and bore $\frac{1}{4}$ -in.-dia. \times $1\frac{1}{4}$ -in.-deep holes. Then continue boring $\frac{1}{8}$ -in.-dia. through holes. Make springs by winding No. 22 music wire around the $\frac{1}{8}$ -in.-dia. section of the pin. Drop the pins and springs into the box front holes. Cut the springs down to adjust the tension until $\frac{1}{4}$ in. of the pin sits above the box edge. Once

the spring and pin have been properly adjusted, trim the pin's $\frac{1}{8}$ -in. section flush with the box front's bottom edge. Bore $\frac{1}{4}$ -in.-dia. \times $\frac{1}{2}$ -in.-deep holes in the front panel to accept the pins when they're pushed down. Then insert $\frac{1}{4}$ -in.-outside diameter \times $\frac{1}{2}$ -in. copper tubing sleeves to form wear-resistant liners. Directly over each pin, mortise the lid's front edge $\frac{1}{8}$ in. deep for a flush-mounted strike plate.

Next, round the edges of the toolbox with a router and a $\frac{3}{8}$ -in. rounding bit. Pass the router to within 1 in. of the

(Please turn to page 183)



WORKSHOP MINICOURSE



Joining with dowels

When I conceived the Minicourse column about six years ago, the idea was based upon what I had learned as an adult education woodworking teacher. The plain truth is that just about every student who enrolled did so to learn the basics. Thus, zeroing in on the basics has been our aim in this space. Judging by reader response, the column has been right on target.

One reader, Bob Parker of Oklahoma City, wrote: "You might consider some articles on joining with dowels. I am strictly a novice and I would appreciate some pointers."

Bob goes on to emphasize that it is the basics that he is interested in—choosing dowels, dowel length and so on. In short, he said that he hasn't been able to find the basic information that he wants.

As simple as the dowel appears, there is much to be learned about using this effective joining tool.

Selecting dowels

Except for very rare instances, you should always work with hardwood dowels.

The cheapest way to buy them is in 3-ft. lengths at a hardware store or lumberyard. You will find hardwood dowels available in a variety of diameters. I keep a supply of $\frac{1}{4}$ -, $\frac{3}{16}$ -, $\frac{1}{2}$ - and $\frac{3}{4}$ -in. dowels on hand in wall-hung canisters. This inventory services about 90 percent of my dowel needs.

Points to remember

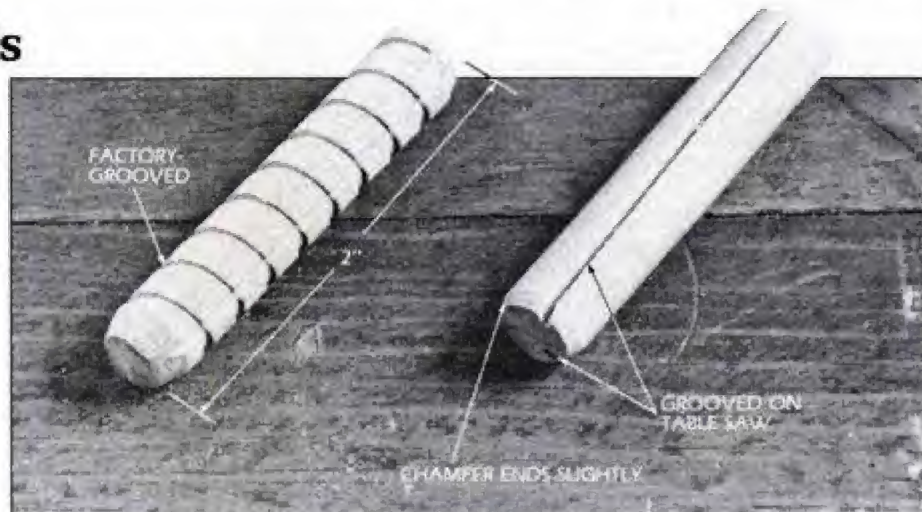
There are three very important points to keep in mind when using dowels to join boards:

1. The dowel holes must be bored deep enough to provide a slight "well" at both ends of the dowel (see photo at bottom right).

2. The dowel must be scored with glue-escape grooves so that glue can be squeezed one way or the other. Failure to provide such relief can result in pressure that can split the boards.

3. For a craftsmanlike dowel joint—which means a glue line that's just about invisible—you must make sure to use clamps.

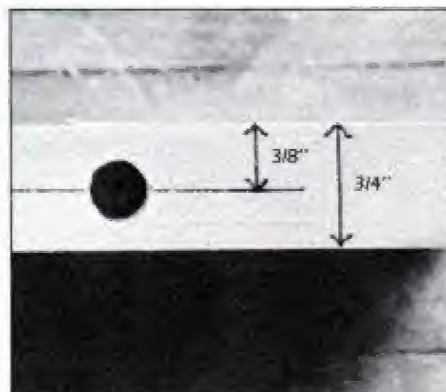
More about dowels, and the right way to use them, next month. **FW**



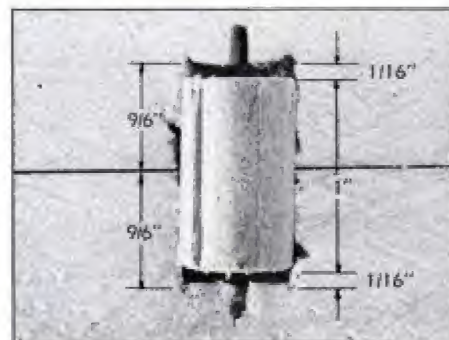
1 To be used effectively, dowels must have a glue-escape groove. If you do a lot of doweling, it pays to buy the commercially available ringed type (shown at left). For the occasional dowel job, and where special lengths are required, buy a 3-ft. length of dowel, cut escape grooves on table saw, then cut dowel to length.



2 Two other techniques for roughening a dowel surface before inserting it into hole: Left, use a smooth file corner to cut nicks around dowel perimeter. Right, grip a length of dowel with pliers, drag it to end to create grooves and texture.



3 Except for special assemblies, a dowel should always be located at exact center of workpiece edge, as here.



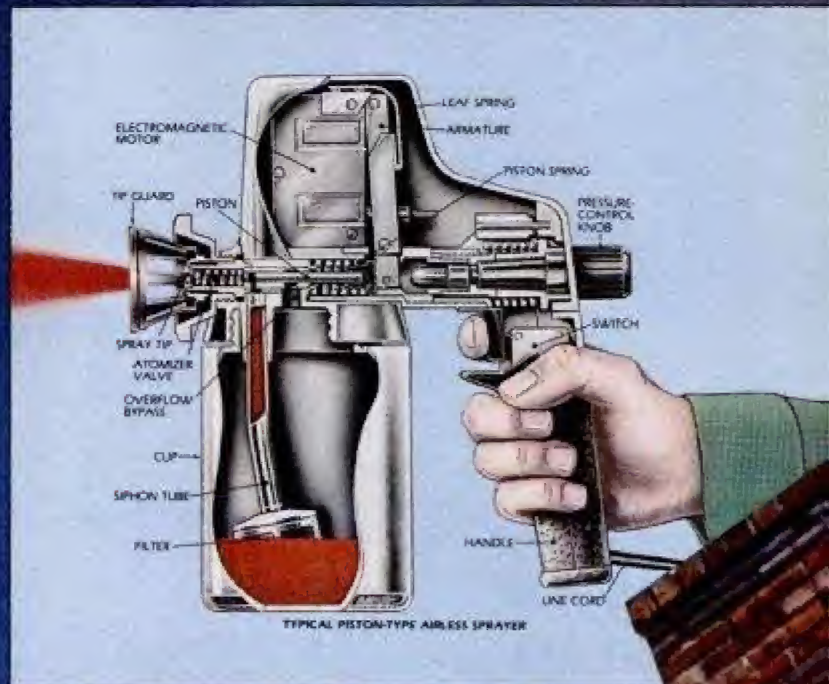
4 Holes for the dowel should be bored to a depth that leaves space at both ends for glue to escape to. Here, holes in both boards were bored to a $\frac{9}{16}$ -in. depth to receive the 1-in. dowel.

'83 HOME IDEAS GUIDE

Now is the time to get your house into tip-top shape. Here are the how-to tips that'll make your repairs easier, and ideas to make your improvements the best-looking ones on the block.



Window treatments that save energy

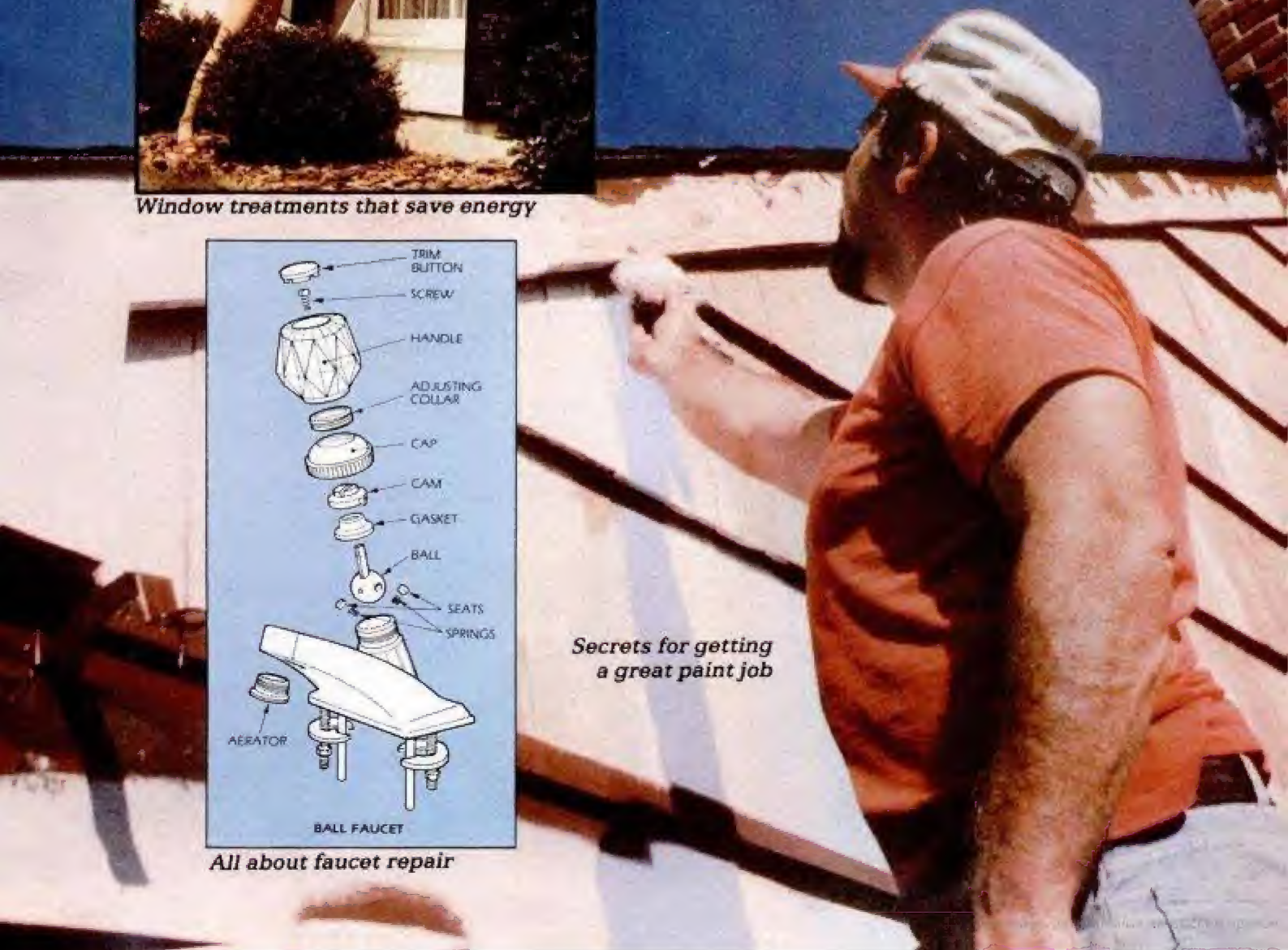


How a pro paints a house with a spray gun



All about faucet repair

Secrets for getting a great paint job





**Even more impressive than what they can do
is how many years they can do it.**

What you can put on a John Deere 650 or 750 Compact Utility Tractor goes on and on; there's a list of more than 20 power-matched implements, including mid- and rear-mounted grooming mowers, a rotary cutter, box scrapers, front and rear blades, rotary tillers, a front loader, a log splitter, a posthole digger and a post driver, to list a few.

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And both come equipped with big-tractor standard features: a sliding-gear transmission with 8 forward and 2 reverse speeds; differential lock; Category 1 3-point hitch; 540-rpm rear PTO; hand and foot throttles; and adjustable rear wheel tread. All that, plus a reputation for reliability that's second to none. And a dealer organization to match.

The John Deere 650 and 750. You'd have to look a long, long time to find compact utility tractors built to last longer.

For the name of the nearest dealer, or a free folder on John Deere compact utility diesel tractors, call 800-447-9126 toll free (800-322-6796 in Illinois) or write John Deere, Dept. 67, Moline, Illinois 61265.


Nothing Runs Like a Deere®



The Right Way To Paint Your House

Here's a complete guide for getting a high-quality exterior paint job.

BY CLIFF GROMER
PM photos by the author



Bare areas on shingles were spot-primed; painter now applies a primer—tinted with finish color—to those spots. Finally, the finish coat goes on, starting at the top.

When you decide to paint your house, you want the best job possible without expending more money and effort than necessary. And you want the assurance that you won't have to repaint again sooner than you should have to.

Start by getting organized. Check the exterior of your house and jot down notes about areas that require special attention. After sizing up the job, gather all the equipment and materials you'll need so that work can progress without interruption. Repair any dam-

aged trim and siding. Replace defective gutters and leaders (but keep in mind that painting may be easier and more thorough if done with old gutters and leaders off and before new ones are installed). Cut or tie back shrubbery that brushes against siding or interferes with work, so that you'll be able to go nonstop.

Analyzing symptoms

Different types of paint failure are symptoms of conditions that should be corrected if you want your paint job to last. Moisture problems are the primary cause of paint failure.

Condensation that works its way from inside the house through the siding lifts paint as it evaporates. In areas where there is excessive blistering and peeling, place a vapor barrier between



Remove all of the blistered and peeling paint, using wide putty knife or scraper.



Use wire brush to remove loose paint and dirt on wood, metal, masonry surfaces.

the interior wall and the siding, on the room side of the insulation. Another cure is to install small screened vents in the siding through which moisture can escape.

Peeling can also result from a surface that is too hard, smooth, glossy or dirty. Whereas peeling due to moisture tends to expose the bare siding, peeling caused by a bad surface flakes down

Latex paint and primer, ladders:
Sears, Roebuck and Co.
Caulking material: UGL
Brushes, scrubbers, pad applicators:
Kiefer Brush Co.
Paint contractor/consultant:
Russell Winters, Old Bridge, N.J.



A special scrubber tool is useful for cleaning and smoothing rough surfaces.



For a smooth finish use 100-grit sandpaper to feather all sound paint edges.



Remove mildew and chalking stains by washing with a solution of trisodium phosphate, detergent, bleach and water.



Remove dried caulking from the joints between siding and window frames. After priming, lay a fresh bead of caulking to seal all joints around the frames.



Press glazing compound around window panes with fingers. Smooth this with a corner of a putty knife pressed against glass. Excess peels off neatly.



Secure loose siding by face-nailing it with galvanized nails. Replace siding that's rotten or damaged beyond repair.

only to the offending layer. Sand the poor surface with 100-grit sandpaper to clean and roughen it for improved paint adhesion.

Alligatoring is usually caused by the build-up of too many layers of paint. The remedy for this paint problem is to strip off all the old paint layers by disc or belt sanding or by applying chemical stripper.

All unsound paint must be removed; there are several options for removal: In most cases, a putty knife or a hooked scraper will do. To remove large amounts of paint or to get down to bare wood, use a disc sanding accessory with a portable drill. Sand first with medium paper, then with fine. Sand out swirl marks by hand.

Bleeding and stains

Sometimes it is difficult to differentiate between dirt and mildew on siding. Both appear as dark stains on the surface and both prevent paint from bonding. Dirt will usually wash away with soap and water, but mildew is more stubborn. The best way to remove mildew is with bleach. The appearance of mildew is also a clue that a fungicide should be mixed into the paint.

Where rusty nails cause staining, set the nailheads slightly below the surface

and fill the holes with an exterior wood filler. Prime the filler with corrosion-resistant primer.

Resin from knots often bleeds through paint and appears in the shape of the knot. To prevent a recurrence, use a turpentine-soaked rag to remove

as much resin as possible from the knot. Then coat it with a special knot-sealer available at paint stores.

Pink or brown stains can result from the water in latex paints dissolving some of the tannin in wood. This is a common problem when cedar and red-

PRIMER/SURFACE COMPATIBILITY

These charts show primers and top coats right for exterior surfaces. Find primer or choice of primers for the surface, then top coat; or work backward from desired top coat to find primer. Make sure coatings are right for the surface.

PRIMER TYPE	SURFACE TYPE									
	Smooth wood siding	Rough sawn siding	Shingles and shakes	Plywood	Wood trim	Concrete block, stucco	Brick, stone, cinder block	Iron and steel	Galvanized steel	Aluminum
1. Oil Primer	•	•	•							
2. Alkyd Primer				•						
3. Latex Primer	•	•	•	•						
4. Stain-Blocking Primer	•	•	•	•	•					
5. Alkyd-Base Metal Primer						•	•	•		
6. Oil-Base Metal Primer						•	•	•		
7. Latex Metal Primer						•	•	•		
8. Portland Cement Paint (for metal)						•	•			
9. Masonry Surface Conditioner				•	•					
10. Portland Cement Paint (for masonry)				•	•					
11. Top Coat Material Used for Primer				•	•					



Quality brushes have a strip in the heel and split bristle-ends called "flags."



"Boxing" paint—mixing contents between cans—will ensure uniform color.



Working with a pad applicator or roller tray can save you time on large areas.



When painting windows, you get more control using an angle-cut sash brush.

wood are painted. Use a stain-blocking oil-base primer to prevent it.

It's a good idea to wash down your entire house before painting, particularly if you find chalking of existing paint. The best all-purpose mixture for washing surfaces is made from $\frac{2}{3}$ cup

of trisodium phosphate, $\frac{1}{2}$ cup of detergent (without ammonia), 1 quart bleach and 3 quarts water.

Caulking, glazing, priming

The joints where siding meets door and window casings must be sealed.

Examine the old caulking and remove all cracked and failing beads. For the best seal, use silicone caulking on a primed surface.

On older houses and where glass has been replaced, joints around window panes can be sealed with glazing compound. Remove dried putty and replace it with fresh glazing compound as shown in the photo on page 116.

All bare wood, new caulking and new glazing compound should be primed before the finish coat is applied. Priming seals porous surfaces and provides a good bonding texture for the topcoat. Be sure to select a primer that's compatible both with the surface being painted and the topcoat material. Use charts below as a guide.

Exterior paints

Exterior paints fall into two major classifications: oil-base and latex (alkyd paints are oil-base but have acids mixed into their formula). Both are suitable for exterior painting, but each has different workability and wear characteristics.

The linseed oil and solvents in oil paints penetrate wood for superior adhesion. Alkyd paints dry a little faster and smoother than simple oil-base paints. Working with oil paints is slow. Each brushful needs to be worked to form an even coat. Drying time of about 24 hours is required between coats. Clean-up requires turpentine or mineral spirits. Both are flammable and caustic.

Latex paints use acrylic polymers as a binder and water as the solvent. They form a flexible, breathing layer on the surface. Latex paint is best applied in heavy coats, not brushed out.

Oil-base paints can yield a higher luster and stand up somewhat better than latex in high-traffic areas. But latex colors are more resistant to fading. Cleaning up after a job with latex paint is simpler, requiring only soap and water.

With either type of paint, color can significantly affect durability. Bright yellows and reds are most likely to fade because of the effect of the sun's ultra-violet rays on their organic pigments.

Estimating paint quantity

For most house paints, manufacturers estimate that a gallon will cover approximately 450 sq. ft. To determine how many gallons to buy, measure the perimeter of your house, multiply it by the average height, subtract the area of doors and windows, then divide by 450 to get the number of gallons needed per coat.

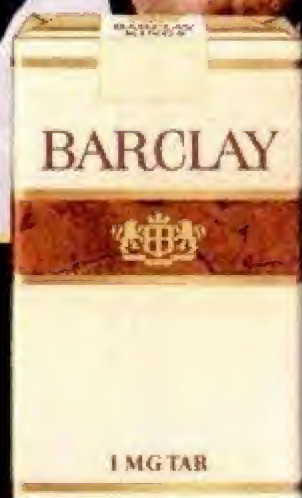
For rough or porous surfaces, add 20 percent to the estimate. Add 10 percent for siding applied 6 in. or less to the weather (6 in. wide or less; extra paint

PRIMER/TOP COAT COMPATIBILITY

TOP-COAT TYPE	PRIMER TYPE										
	1	2	3	4	5	6	7	8	9	10	11
Oil-Base Gloss House Paint	•			•		•			•		
Oil-Base Flat House Paint	•			•		•			•		
Alkyd-Base House Paint		•		•		•			•		
Alkyd-Base Enamel		•		•	•				•		
Latex Flat House Paint			•	•			•		•		
Latex Trim Enamel			•	•			•		•		
Alkyd-Base Masonry Paint											
Latex Masonry Paint									•		•
Alkali-Resistant Coatings									•		
Portland-Cement Paint (for masonry)									•	•	•
Oil-Base Exterior Metal Paint						•					
Alkyd-Base Exterior Metal Enamel					•						
Aluminum Paint					•						
Portland Cement Paint (for metal)								•			

Regular, 1 mg. "tar", 0.2 mg. nicotine
av. per cigarette, FTC Report Dec. '81.

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*99% tar free.*TM

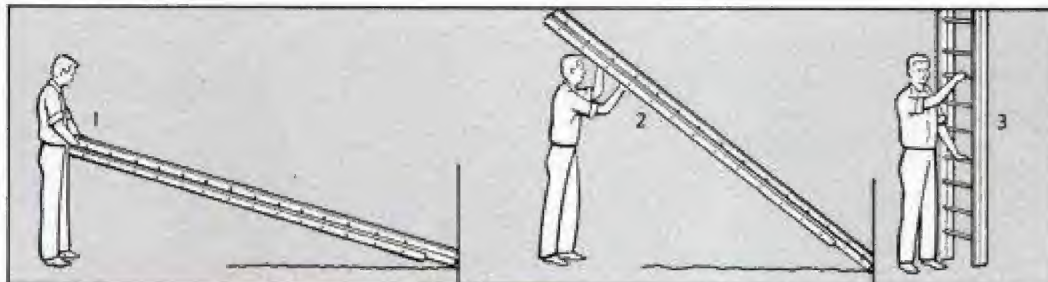
The pleasure is back.
BARCLAY

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

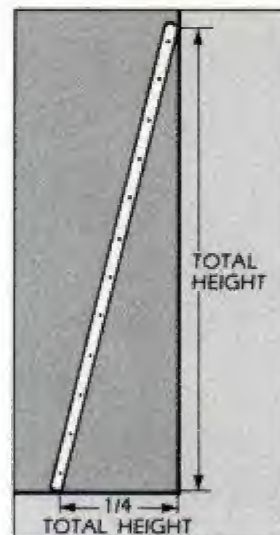
USING LADDERS SAFELY

Ladders are rated by category according to their load capacity and durability. The rating appears on a sticker found on one of the ladder rails. Ladders marked as Type I are rated for loads up to 250 lbs. Those marked as Type II carry a 225-lb. rating. Type III ladders are not advisable for exterior work.

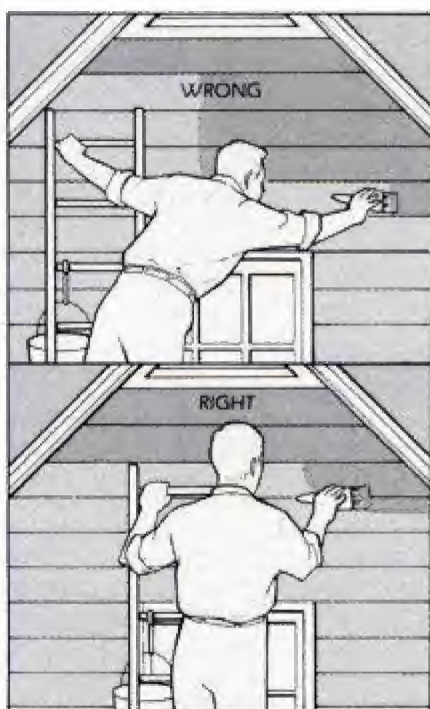
The length of a ladder is another critical safety factor. Check the size chart below to select a safe length for the particular job you have to do. Never store a wooden ladder outside exposed to the weather. And be aware of overhead wires, especially with an aluminum ladder, because of the shock hazard.



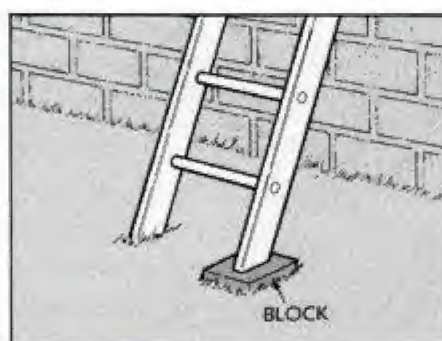
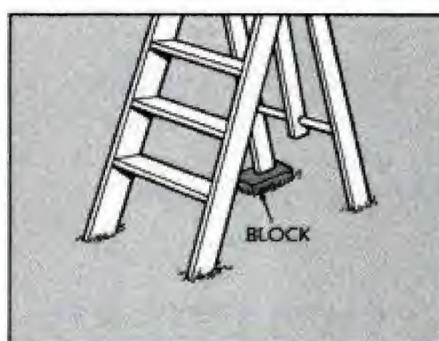
To raise a tall ladder when you're working alone: 1. Lift the top end with the feet resting against a wall; 2. "Walk" the ladder up with your hands, rung by rung; 3. Achieve a vertical balance.



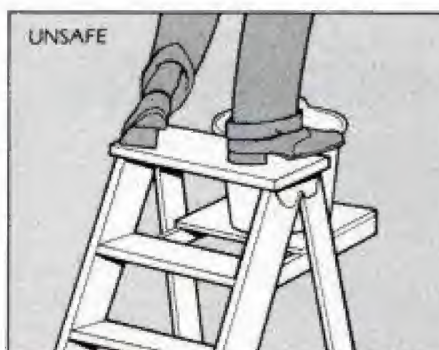
Relation between ladder height and feet position.



Never over-reach when you're standing on any ladder. If it slides along the house wall, you may lose your balance and fall. The center of gravity must remain between the ladder feet.



The feet of a ladder must always be level to assure stability and prevent slipping. Use blocks to shim them level or to keep them from sinking into soggy ground.



Never stand on stepladder's top shelf. One step down gives you better position to maintain your balance; two steps down means less bending down to load your brush.

is needed to cover more butt edges). Add 33 percent for corrugated metal and 100 percent for the first coat on concrete or cinder block.

To estimate the amount of paint needed for trim, figure that one gallon will cover eight doors or windows, or 200 linear feet of gutter and fascia.

Paint applicators

For primers and first coats, good quality brushes offer you the most flexibility. Use a 4- to 6-in. brush for siding and a 2- to 3-in. brush for windows and other narrow trim. Nylon brushes

(Please turn to page 120)

HOW TO SELECT THE RIGHT SIZE EXTENSION LADDER

When working on a roof with a height of*	or, when the top support point against a vertical wall will be	select a ladder with a manufacturer's designated size of	Maximum Extension (open)	Minimum Extension (closed)
5 to 11½	7¾ to 12¾	16	13	8
6¾ to 15½	9½ to 16½	20	17	10
8¾ to 19½	11½ to 20	24	21	12
10½ to 23½	13½ to 24	28	25	14
12½ to 27	15½ to 28	32	29	16
14½ to 31	17½ to 32	36	33	18
16½ to 33 (wood)	19 to 34 (wood)	40	35 (wood)	20
34 (metal)	35 (metal)		36 (metal)	

*Selection of a proper ladder for use when you're climbing onto and off a roof must allow for an extension of 1 to 3 feet above the roof eave.

All dimensions above are given in feet.

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Continued from page 119

should be used for latex. Use natural bristles for oil paints.

Rollers and pads speed up second coats as long as they're used in conjunction with brushes that allow you to reach siding butt edges, and behind shingle butts. Thick-nap rollers are especially good for painting rough or porous surfaces like cinder block, and certain textured sidings.

Most applicators other than brushes can be fitted with extension poles. This can save some climbing and reaching and also increase the length of your strokes.

The right conditions

Temperature and humidity at the time of paint application can affect the quality of the job. It's safest not to paint if the temperature is above 90° F. or below 50° F., since extremes can and will cause paint to cure improperly.

It's safe to paint with latex if the surface is damp, but it must not be wet. When painting with oil-base, wait at least a day after rain before painting. Rain on oil or latex surfaces that aren't dry may cause spotting in the finish.

It's best to paint with an oil-base paint in early spring or fall—times when insect populations are low. Resins in the paint tend to attract bugs.

Applying paint

Many pros recommend painting the trim before siding. By doing this, you can avoid placing ladders against freshly painted surfaces. Work from the top of the house down to avoid dripping paint on previously painted surfaces.

Fill a working pail about half-full. Dip your brush only about one-third the length of the bristles and tap it gently against the side of the can to remove the excess paint. Don't drag it across the rim. Apply a healthy dab of paint to the surface and work it into an even coat using the tip of the brush. Apply paint to siding butt edges first, then to the weatherface.

With latex paint, work from the dry area into the wet to avoid lap marks. If you must stop before a side is finished, pick a spot where some architectural feature breaks up the surface (for example, the bottom of a shingle course or a corner) to avoid creating lap marks when you resume.

Don't try to extend paint beyond the manufacturer's recommendations for coverage. If you do, it will not perform up to specifications. If you're trying to get by with a one-coat color change, but finding the new paint doesn't hide the old, try adding a little burnt umber. If you're satisfied with the coverage after testing, mix as much paint as you'll need using the boxing method to ensure uniform color. **PM**

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Kurt Laemmerhirt (right) shows the author one of the time-saving tricks of the trade: Instead of masking, he sprays windows, then scrapes glass.

A Pro's Secrets For Spray Painting A House

Airless sprayers do the job right—and in a lot less time.

BY MICHAEL CHOTINER ASSISTANT HOME AND SHOP EDITOR

It's no secret that spray painting is much faster than painting with a brush—yet relatively few do-it-yourselfers consider spray painting at house-painting time.

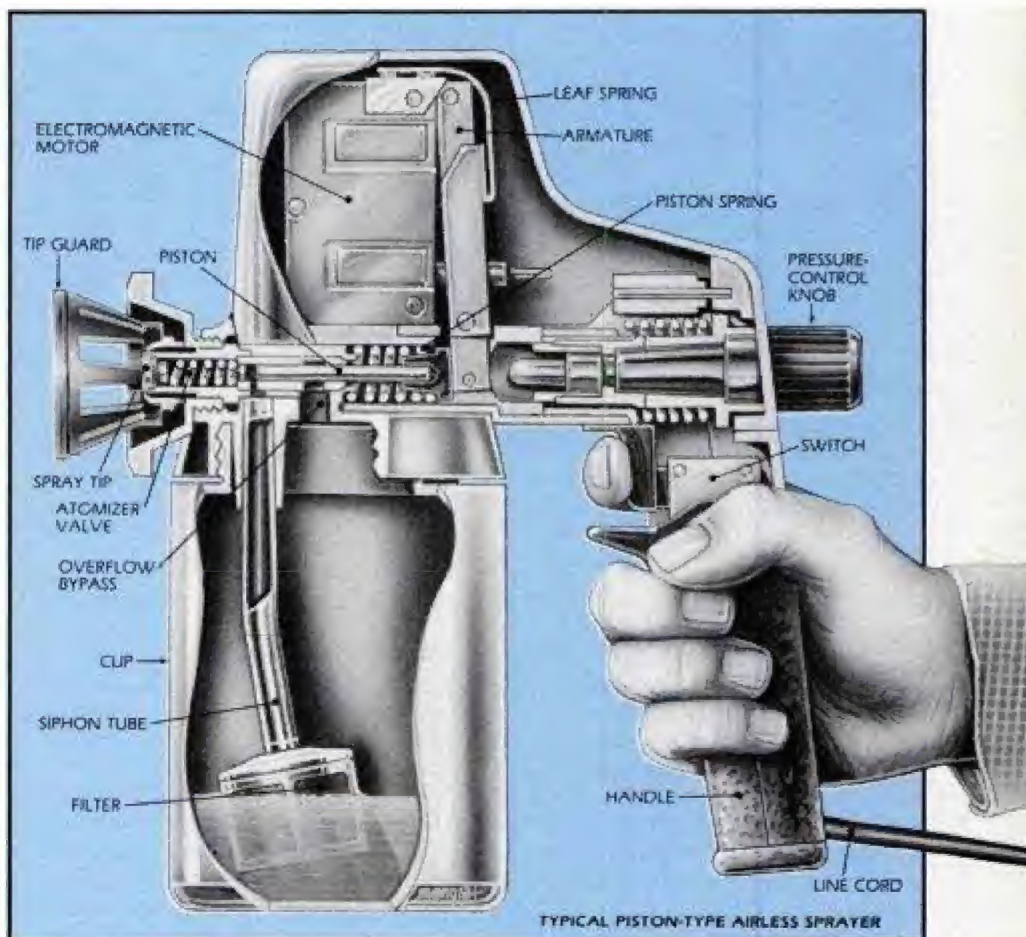
A great variety of airless spray equipment is available to homeowners. While high-performance commercial equipment is relatively expensive (\$300-\$3,000), it can be rented for about \$75 a day. Airless units designed for do-it-yourself house-painters cost \$100 to \$200—not much when you consider that spraying is at least twice as fast as brushing and that it drastically reduces fatigue.

Reliable equipment is only part of the story—know-how is just as important. We asked Kurt Laemmerhirt of Toms River, N.J.—a professional with nearly 40 years' experience—to help us spray paint a house. His expertise not only helped us to do the job fast, but also the right way.

Why 'airless' spraying?

Conventional sprayers use air to atomize paint to a fine mist. For this you need a compressor, and that means a significant investment. It also means that paint follows the airstream out of the tip in a sort of cloud, causing a high percentage of the paint to trail away from the surface being painted. The trail is called *overspray*.

There are two basic designs for airless sprayers. In piston-type systems, paint is forced through an atomizing valve at high pressure. Diaphragm pump systems atomize paint by means of a mechanical screw and deliver it to a gate valve at relatively low pressure. In



Paint is drawn into siphon tube and pumped at high pressure through atomizer valve.

both cases, the result is a cleaner, faster spraying system.

Most sprayers designed for do-it-yourselfers have the pump built into a handheld unit. Since piston-type airless units deliver paint at pressure high enough to break skin at close range, you must keep your fingers away from the tip to avoid getting an injection of paint or solvent. Most sprayers for do-

it-yourselfers cannot operate without pressure-diffusing tip guards and are safe. All commercial airless sprayers are labeled with warnings against directing the spray tip at any part of the human body.

Preparation

Prepare surfaces for spray painting as you would for brushwork. Trim and

PM photos: Peter Tenzer
Equipment: Wagner Spray Tech Corp.
Latex paint: PPG Industries



Mask fixtures, doorknobs and latches with paper or plastic. Tape lamp base carefully for even contrast line.



Before spraying, remove all nameplates, screens, storm sash and other fixtures that are difficult to mask.



Cover plants near the house with dropcloths. Cut or tie back all foliage that brushes against the siding.



Strips of hardboard or scrap come in handy for holding down dropcloth edges. Space them 1/4 in. from foundation.



Shutters were laid flat to reduce the chance of paint sag and drips. We numbered the backs of the shutters to keep track of where they came from and replaced them using the same nail holes.



An extension tube allows you to work directly from the can. Clip the can to your belt so you can keep a hand free.

siding must be clean and free of unsound paint; all bare spots should be primed.

Mask lamps and other fixtures. If you remove doorknobs and latches, stuff the holes with paper to keep out the spray. Close all windows tight.

Remove screens and storm windows. Aluminum storm doors and windows can be removed, but consider that factory-finished metal surfaces make an excellent base for spraying latex when they are clean.

Windows may be masked, but Kurt feels that's time-consuming. Scraping paint from glass panes goes quickly. The 8-over-12 windows on the house we painted took about 10 minutes each to clean.

Airless units can be used to spray latex, oil and alkyd-base paints, also for stains and varnishes. All paints are somewhat abrasive and latex paints will cause more wear to equipment than other types. When spraying acrylic latex, resins tend to build up on pistons and may cause them to seize. To pre-

vent piston seizure, mix Floetrol—a lubricating additive—with paint.

Spraying techniques

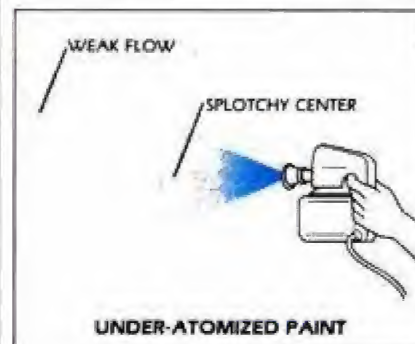
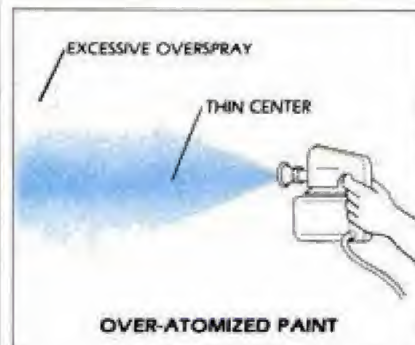
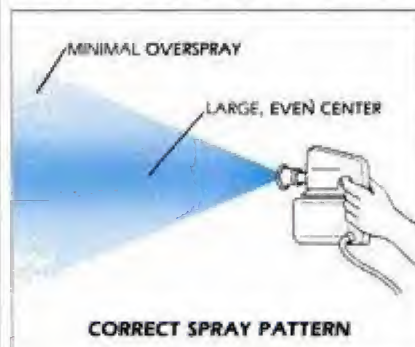
Prime the pump by first spraying onto paper or other uncritical surface. If the pump won't prime, the paint probably needs to be thinned.

Start the sprayer with the nozzle pointing away from (off) the work surface, then move it into position about 12 in. away. Work with rhythmic strokes, keeping the sprayer upright and parallel to the plane of the wall. Don't go over previously painted areas until they are dry. Work from the top down, spraying a thin, even coat. If drips, runs or sags occur, remove excess paint with a brush. Remember that several thin coats of paint produce a better finish than one thick one.

Remove all masks when the paint is dry to the touch. Inspect the job; areas where masking blocked paint and edges of double-hung windows will need to be finished with a brush.

If trim will be a different color from

ATOMIZATION PATTERNS



Overatomization is caused by using too large a tip, too much pressure or paint that's too thin. Underatomization results from using too small a tip, too little pressure or paint that's too thick. Most of the spray units come equipped with a pressure control knob and a choice of spray tips that have different aperture sizes.

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Sears, however, was not content to leave well enough alone. So in 1971, Craftsman lawnmowers had the first no-maintenance, replaceable air filter. A big improvement over the sponge filter, which requires frequent cleaning and soaking with oil.

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And now's a perfect time to make a Craftsman Eager-1, 20-inch lawnmower, with 3.5 reserve power engine, your choice. Because from April 3-16 it's the Craftsman Choice for just \$189.99... a \$30 savings. And that's an "innovation" that's pretty hard to improve on.

*Based on independent survey data July 1981-June 1982

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Use hardboard or cardboard strip for a handheld shield to protect adjacent surfaces, such as roof shingles, from overspray.



Use shield to mask trim from the siding color. Here, casing face is left partly exposed for thorough coverage at siding-casing angle.



Latex paint scrapes from the window panes easily after about two hours. Oil-base paint would need to dry somewhat longer. If paint is allowed to cure, however, it becomes very difficult to remove.



Touch up the oversprayed areas on the window casings and other trim with a brush when paint is dry to the touch.



When the job is finished or when you set the sprayer aside for a while, flush it out with the appropriate solvent.

siding, paint the trim first. Use a handheld shield to mask trim from siding.

Equipment maintenance

The single most important maintenance practice for airless sprayers is to keep them clean. If you work directly from the paint container with a long siphon tube, tape the tube to the container rim to keep it off the ground. Flush the tube thoroughly with solvent if it should contact a foreign substance.

When you're finished for the day, spray solvent through the gun for several minutes. Then, disassemble the unit and soak the nonelectrical parts in solvent. Wipe all built-up paint from both cup and cap. Reassemble the unit and put a drop of light oil in the suction hole. Switch the unit on for a few seconds to circulate the oil.

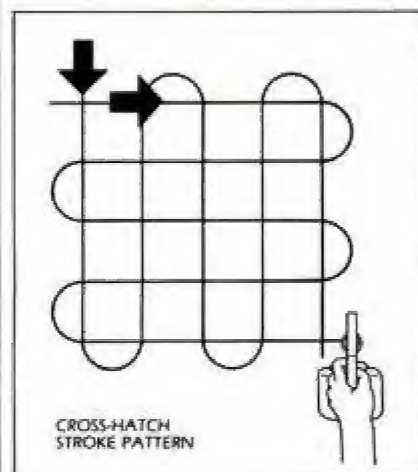
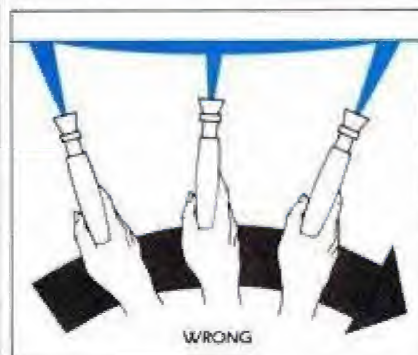
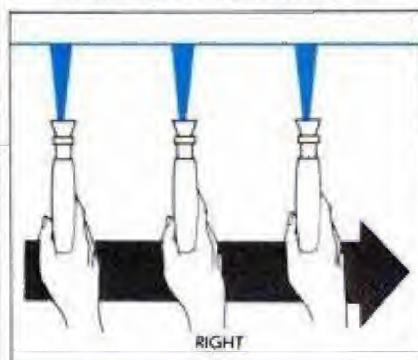
Several parts on some airless spray equipment are particularly prone to

wear. After spraying 10 to 15 gallons of latex, many models designed for homeowner use will require replacement of the spray tip and atomizer valve. Pistons should be checked and replaced if scored. Piston springs are subject to wear and breakage. Replacement of key parts should be under \$20. **PM**

MANUFACTURERS LIST

For consumer information about airless spray painting equipment contact:
Acme Burgess, Rte. 83, Grayslake, Ill. 60630.
American Products, 5550 Elston Ave., Chicago, Ill. 60630.
Binks Manufacturing Co., 9201 West Belmont Ave., Franklin Park, Ill. 60131.
Campbell-Hausfeld, Div. of Scott & Fetzer Co., 800-T Production Drive, Harrison, Ohio 45030.
DeVilbiss Co., Box 913-T, Toledo, Ohio 43692.
EZ Painter, 4051 South Iowa Ave., Milwaukee, Wis. 53207.
Graco, Drawer 1441, Minneapolis, Minn. 55440.
Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684.
Speedo Manufacturing Corp., 4631 Winfield Rd., Houston, Tex. 77039.
Wagner Spray Tech Corp., 1770 Fernbrook la., Minneapolis, Minn. 55441.

SPRAYING TECHNIQUE



Keep the spray tip at an even distance from the surface and use cross-hatch strokes to spray an even coat.

CAMEL

Where a man belongs.

A man in a tan shirt and brown pants stands in a desert camp, holding a rifle over his shoulder and smoking a cigarette. To his left is a biplane and a tent. In the foreground, two packs of Camel cigarettes are displayed: Camel Lights and Camel Filters. The background shows a desert landscape with mountains.

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Build PM's In-The-Wall Workshop

Created out of redwood, this cabinet will look good in any family room. Opened, it's an instant workshop for both hobbyist and craftsman.

This handsome redwood workshop is a fully equipped, organized work center designed for either in-the-wall installation or as a surface unit fastened to the wall.

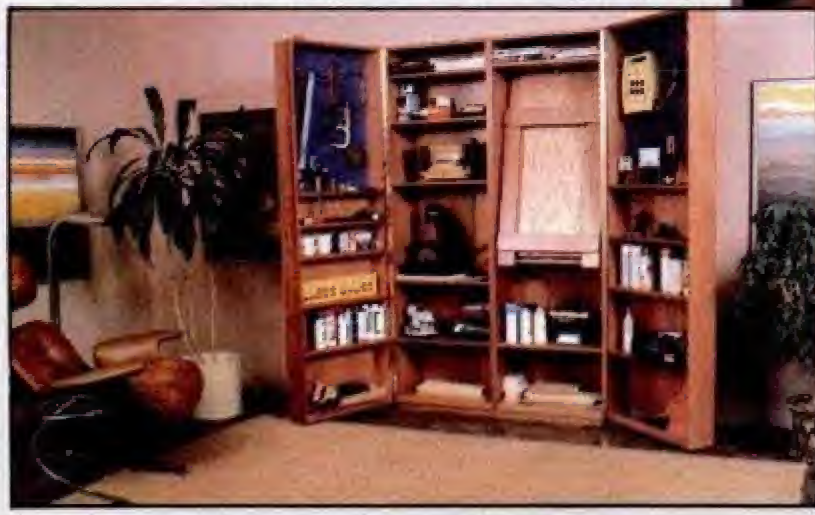
Recessing the workshop between wall studs results in a built-in that reduces the unit's projection into the room by 4 in. If the wall is a load-bearing one, reinforce the existing studs as shown in the drawing and install a header to the wall opening as illustrated. If you decide to make your workshop a free-standing unit, the electrical outlet box should not be side-mounted. Instead, mount the outlet on the cabinet back. If installed as a recessed unit, secure the cabinet to the studs with 2-in. No. 14 screws driven through the cabinet sides. If the unit is free-standing, secure it by screwing through the cabinet back into the wall studs.

The workshop is the result of a joint effort by the California Redwood Assn. and Popular Mechanics. It is made entirely of clear, all-heart KD redwood. If you wish to economize on the cost of clear redwood, you can use a clear sapwood grade.

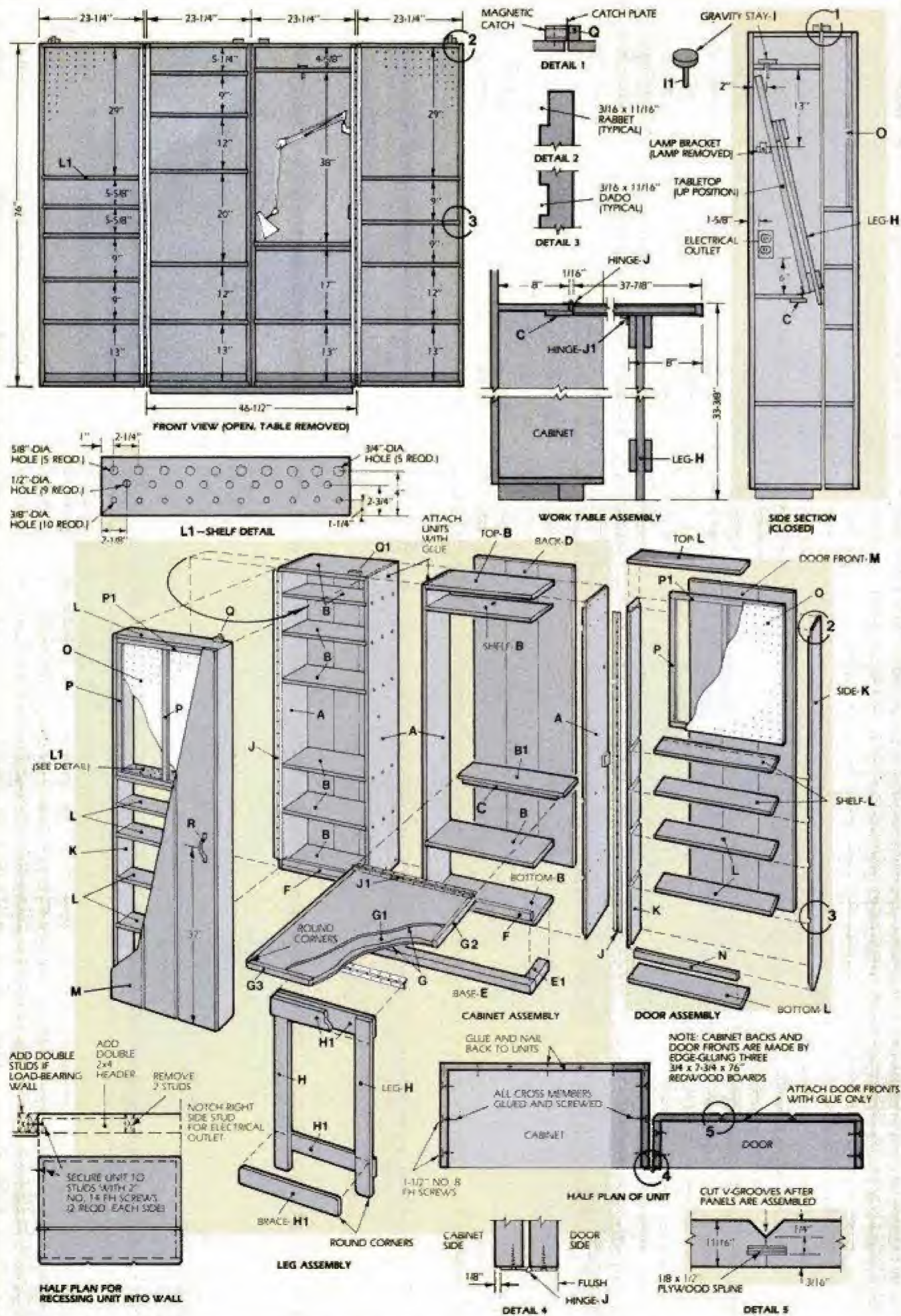
The cabinet parts are cut from one-by (nominal 1-in. stock) boards in 4-, 6-, 10- and 12-in. widths. Notice that 1-in.-nominal redwood is actually dressed to $1\frac{1}{8}$ in. thick. Since redwood is soft, the fold-down tabletop is made of $\frac{1}{4}$ -in. hardwood veneer plywood laminated to both sides of $\frac{3}{4}$ -in. fir plywood. We used $\frac{1}{4}$ -in. oak veneer plywood, but birch, maple or ash can also be used.

The workshop is built as two individual units which are glued together side by side after they're assembled. Construction starts with the door fronts and back panels which are made by edge gluing three redwood boards with plywood

This space-saving workshop provides an organized work center for creating home projects. Open (below), it displays ample shelving for tool storage and a fold-down workbench. Closed (below, right), the redwood doors conceal the work center and the room is returned to everyday use.









Lay out boards for edge-joining to get a pleasing grain pattern. Use chalk to key sequence with letters and numbers.



To aid in cutting spline grooves, add a wood auxiliary fence to the rip fence and clamp a featherboard to the saw table.



Light pressure on C-clamps holds the boards flat. Tighten up on the bar clamps to draw the edge-joints closed.



The wide end cutoffs of edge-joined panels are best handled with a portable circular saw and a clamp-on guide.



Before assembling the units, determine the electrical outlet location and use a sabre saw to make the cutout.



The pilot holes are bored into the shelf ends after the plug and pilot holes have been bored in the side pieces.

splines. The splines reinforce the joints and ensure flush surface alignment.

Successful edge gluing requires absolutely straight mating edges. Check the edges of the boards and eliminate any unevenness; to cut perfectly true edges, tack-nail a straightedge guide to the board with a slight overhang. The straightedge then rides against the table saw rip fence. Many craftsmen find a length of Reynolds H-section aluminum extrusion works well for this purpose.

Lay out the boards for the most desir-

able grain pattern and key them with numbers and letters using chalk to avoid marring the surface. Select a saw blade with a 1/8-in.-wide kerf for edge-cutting the spline groove. For accurate grooving, attach a 3/4 x 6 x 48-in. board to the rip fence by screwing through the back of the fence and into the board. Clamp a featherboard—a board "feathered" with kerfs positioned against the workpiece to ensure straight cutting—so it abuts the work directly opposite the blade. Note that when a featherboard is used for ripping

it must be placed *before* the saw blade; the exception shown is made only for grooving. When cutting the grooves, keep the same surface of each board against the rip fence; use the chalk marks to assist you.

To glue the boards together without buckling them when applying clamp pressure, sandwich them between three pairs of 2x4 cross supports. Apply glue to the board edges, grooves and splines before joining the boards. Lightly clamp the 2x4 supports to hold the boards flat, then tighten the bar clamps to draw the edge joints closed. After the glue has dried, use a portable saw to make the wide end cutoffs. Finish-sand the inside of all pieces before the next operation.

Dadoes and end rabbets are plowed into the cabinet side pieces to receive the tops, bottoms and shelves. Use a radial-arm saw with a dado head or a router with a mortising bit to make these cuts. Notice that a stopped dado is required at the tabletop shelf location. The dado stops short of the cabinet's front edge. Before assembling the

MATERIALS LIST—IN-THE-WALL-WORKSHOP

Key	No.	Size and description (use)
CABINETS(2)		
A	4	3/4 x 11 1/2 x 76" redwood (cabinet side)
B	11	3/4 x 11 1/2 x 22 1/4" redwood (top, bottom, shelves)
B1	1	3/4 x 8 x 22 1/4" redwood (hinge shelf)
C	1	1/2 x 3 x 21 1/2" hardwood (hinge cleat)
D	2	3/4 x 23 1/4 x 76" redwood, edge-joined (back panel)
E	1	1 1/2 x 3 x 45" redwood (base front)
E1	2	1 1/2 x 3 x 8" redwood (base sides)
F	2	3/4 x 1 1/4 x 21 1/2" redwood (rail)
G	2	1/4 x 20 x 37" oak plywood (tabletop veneer)
G1	1	3/4 x 20 x 37" fir plywood (tabletop core)
G2	2	1 1/8 x 1 1/4 x 37 1/2" redwood (edging)
G3	1	1 1/8 x 1 1/4 x 20" redwood (edging)
H	2	3/4 x 3 1/2 x 32 1/4" redwood (legs)
H1	4	3/4 x 3 1/2 x 21" redwood (braces)
I	1	3/4 x 3"-dia. redwood (gravity stay top)
I1	1	3/8"-dia. x 3" hardwood dowel (gravity stay pin)
J	2	1 1/2 (open) x 72 3/4" continuous hinge (for doors)
J1	1	1 1/2 (open) x 21" continuous hinge (for tabletop)

DOORS (2)		
K	4	3/4 x 5 1/8 x 76" redwood (door side)
L	13	3/4 x 5 1/8 x 22 1/4" redwood (top, bottom, shelves)
M	2	3/4 x 23 1/4 x 76" redwood, edge-joined (door front)
N	2	3/4 x 1 1/4 x 21 1/2" redwood (rail)
O	2	1/4 x 21 1/2 x 28 1/2" Peg-Board
P	6	3/4 x 1 1/8 x 27 3/4" furring strip (Peg-Board frame)
P1	4	3/4 x 1 1/8 x 21 1/2" furring strip (Peg-Board frame)
Q	2	3/4 x 1 x 2 1/2" redwood (catch plate block)
Q1	2	Heavy-duty magnetic catches
R	2	Brass door handles, Amerock No. 8P 302BB

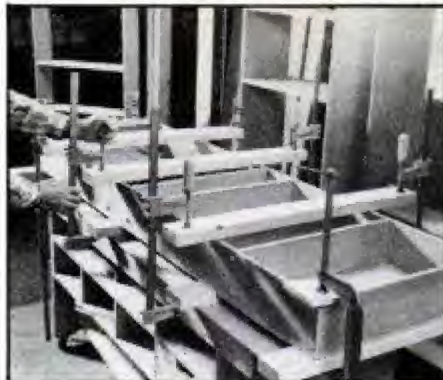
Misc.: Carpenter's glue, 8d common nails (to attach cabinet backs), 1 1/2" No. 8 fh screws (to attach shelves), 1" No. 6 fh brass screws (to attach table hinge to shelf B1), 2" No. 14 fh screws (4, to secure unit), 1/4 x 1/4"-dia. wood plugs, 1/4 x 1/2 x 76" plywood splines, 1 standard electrical outlet box, 1/4 x 3 1/4" capscrew with washer and nut (for installing lamp bracket).

Note: Use nominal 3/4" clear all-heart KD redwood (actual dimension: 1 1/8"). Other lumber as noted.

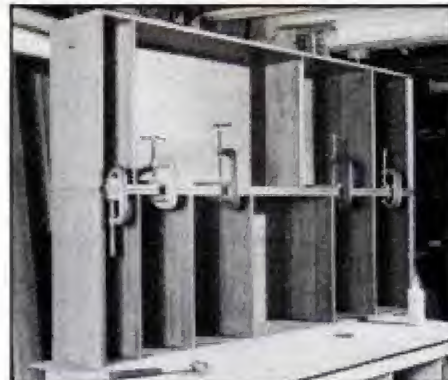
PM photos: Color, Harry Hartman; black and white, Rosario Capotosto
Room styling: Gabe Herrick
Workshop concept: Marshall Roath
Design and construction: Rosario Capotosto
Tools: Black and Decker Service Center, 50 West 23rd St., New York, N.Y. 10010
Electronic equipment: Radio Shack, 250 West 57th St., New York, N.Y. 10019
Lamp: Sears, Chicago, Ill. 60684



End grains receive bead of glue spread evenly with a brush. A second bead of glue is applied at the last moment. Wax paper prevents glue squeeze-out from getting on the back panel.



After glue has dried on the assembled door frames, glue on the front of the doors using the same procedure.



The two assembled cabinets are glued and clamped. Prior to applying clamp pressure, tack in two alignment nails.



Tape door hinge in place, then secure it with three screws. Using a self-centering punch (shown) or an awl, mark remaining screw centers. Be sure the screwheads are even with the hinge surface.



Use a jack to support the tabletop while you're screwing the hinge to the shelf.



The completed workshop is now ready for installation into its wall opening.



Release the gravity stay to lower the tabletop. Hinged log remains vertical.

units, make the cutout for the electrical outlet and bore the holes in the left door's upper shelf.

Follow this procedure for boring screw holes: Bore $\frac{1}{2}$ -in.-dia. \times $\frac{1}{4}$ -in.-deep holes for the plugs. Next, bore $\frac{1}{8}$ -in.-dia. through holes, dry-assemble the parts and bore pilot holes into the cross-member edges. Glue and screw the sides to the cross members and clamp them to their door fronts or back panels, respectively, until the glue sets.

Glued and nailed butt joints attach

the back panels to the cabinets. The door fronts are attached to the door frames with glue only. Tack-nail the door fronts to the door frames and clamp as shown in the photo.

The decorative V grooves in the door panels are cut after the doors are completed. Use a router with a $\frac{1}{4}$ -in. V cutter guided by a straightedge. Facing the guide, pass the router left to right, bearing down firmly to avoid off-course drift.

Glue and tack-nail the two assembled cabinets together. Use C-clamps in front, bar clamps across the back.

Install the continuous door hinge $\frac{1}{4}$ in. from the inside edge of the cabinet. This results in the desired gap between the doors when they're closed. Tape the hinge in place and secure with three screws, one at each end and one in the middle. The second leaf of the hinge is positioned flush to the door frame edge for the necessary offset. A note of caution about hinges: Stanley hinges are recommended simply because they are well made. Many commonly available imports have edge bow which makes them difficult to install properly.

The Peg-Board is glued on the inside of the doors to a $\frac{3}{8}$ -in.-thick furring

strip frame. Cut the Peg-Board with about $\frac{1}{8}$ -in. clearance on all sides. Paint and install the tool boards.

Construct the tabletop by laminating $\frac{1}{4}$ -in.-thick hardwood-veneer plywood to both sides of the $\frac{3}{4}$ -in.-thick fir plywood core. Cover both sides of the core to prevent warping. The tabletop mounts on a backup shelf reinforced on the underside with a hardwood strip. Use 1-in. screws on the hinge's back leaf to penetrate the hardwood.

The worklamp shown (from Sears, No.9 GT 2484, worklight) provides a mounting bracket that screws to a flat surface. For a solid installation, use a $\frac{1}{4} \times 3\frac{1}{4}$ -in. cap screw (not supplied) to mount the bracket. The lamp will clear the retracted tabletop provided you position the bracket precisely as indicated in the drawing.

While the weight and angle of the tabletop allows it to rest safely in the up position, install the simple gravity stay to prevent children from pulling the table down.

For a satin finish that enhances the redwood, apply two coats of Deft semi-gloss clear finish. We used Krylon No. 1910 blue spray paint on the perforated hardboard.

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Energy-Saving Ways With Windows

20th-century materials, old-fashioned ingenuity help produce these new window treatments.

BY JOHN H. INGERSOLL

Our ancestors knew it. Working window shutters were as common as fireplaces in the 17th, 18th and 19th centuries. It's true that one of the reasons for shutters was security. But another was clearly protection from the winter cold.

Here we are in energy-expensive 1983, and window shutters are being rediscovered—though they're not the wooden wind-bangers our forefathers built: We're discovering that window treatments can keep our homes cooler in summer and reduce the need for air conditioning. When high-tech materials are used, shutters, shades, blinds and screens can be lighter, better engineered and far more effective than their predecessors at blocking heat loss and heat gain.

You know from experience that single glazing is a poor insulator. It has a meager R-value (measure of a material's resistance to heat loss by conduction) of 0.9. Double glazing raises the window insulating value to R-1.84, which is far below the R-19 minimum that's expected in present-day wall construction.

Although single-glazed windows in a Michigan home without storms could account for more than 50 percent of the house heat loss in winter, that same building, when fitted with insulating shutters properly installed and used could build up protection against heat loss at windows to around R-10. This would reduce fuel consumption for the house by as much as 25 percent.

Shopping for window treatments

Window-insulating products, often called movable insulation, are for the most part less than a decade old. But now a host of companies are selling materials, kits and finished insulators. Before you buy any of them, however, weigh the answers to these four questions:

1. How much energy do they save? Window insulation ranges in



Solar screen, such as Phifer's Sunscreen (above), blocks out 60 to 70 percent of the sun's heat, thus cutting demand on the air conditioner. To replace conventional

screening you'll need a screen roller (inset). Screening is about \$1 per square foot; new screen plus frame and labor costs about \$2.50 per square foot.

value from less than R-2 to a figure that's very close to R-10. These values represent the rating for the insulation only. When they are combined with existing double- or triple-glazed windows, plus dead-air space between the glazing and insulation, these values in many cases jump above R-12.

2. Are you content with the



Window Quilt is a custom-made shade of five layers of fabric with an R-value of 3.4. The shades are available in 48 colors, seven with a white dot pattern. They range from 22 to 99 in. wide and are up to 158 in. long. The cost is about \$5.50 per square foot. Window Quilts come with concise installation directions and a list of parts shipped.



On a southern exposure, canvas awnings can block from 55 to 65 percent of the heat gain through a window. On a western exposure, blockage can be from 72 to 77 percent, according to the American Society of Heating and Air Conditioning Engineers. Scientists have also found that white or light-colored awnings are best for reducing indoor temperature.

appearance? How will the window or glass door look with insulation? Some of the first-off-the-production-line units lean heavily to the practical. Some more recent models of shutters and shades feature color, pattern or molding on the inside face. Others suggest that you attach the fabric of your choice to the panels or shades.

3. How easy are they to install and operate? Insulating shades operate in practically the same way as ordinary window shades. They are wrapped on spring-loaded rollers. The differences: They are heavier than paper shades, and many slide in tracks rather than swing free. Some of these

(Please turn to page 134)



The bulletin board is an insulated sliding shutter enclosed in Thermal Wall's vinyl framing system. Parts needed to cover a 30x60-in. window cost about \$58 and include vinyl valance, vinyl frame, weatherstripping, corner reinforcements and hardware. You supply board insulation and decorative panel and assemble the parts. A swinging shutter system is also sold. The maker claims that a 1-in.-thick urethane foamboard backed with aluminum foil and topped inside with fabric racks up an R-12 rating.



The Insulating Curtain Wall, operated electrically, has an R-9 to R-12 insulating value. An outside temperature sensor signals the automatic shades to open or close. Thermal Technology, the maker, provides six finishes for the interior surface; or you can attach your own fabric following directions provided. The surface facing outdoors is a reflective metallic. Price for a 4x4-ft. covering (smallest size) is \$780. The company also makes a manually operated version called SuperShade which has an R-value of 4.

'83 HOME IDEAS GUIDE

(Continued from page 133)

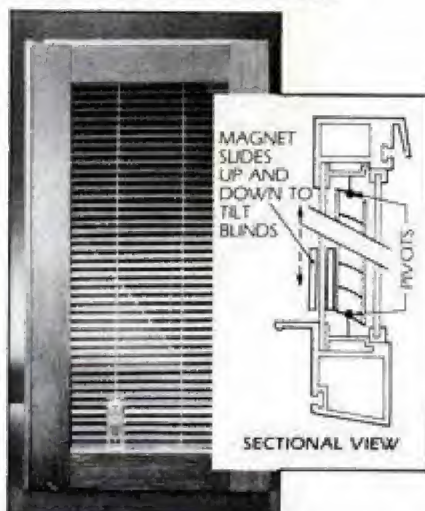
shades can be electrically operated.

For the most part, the new insulating shutters are positioned inside the house. They lie back against the wall and swing forward or slide over the window. For an exception, one type (Thermax) is a panel that must be inserted and removed manually when not in use. Shutters are available as sin-

gle or double-fold panels. The installation of insulating shades and shutters is a task that's no more difficult than the putting up of a Roman shade or louvered, interior shutters. Insulation fixed within windows—some blinds, for example—comes built into the window and calls for window replacement. Insulating draperies require only a couple more steps beyond the installation of standard draperies.

4. Finally, what is the cost? At present, the costs for several of the more innovative treatments are somewhat erratic. The producers of these products presently have limited production-line capabilities. Some units are practically handmade. As production output increases, the prices should stabilize. Approximate prices for the treatments shown are revealed in the captions appearing below them. You can write to the manufacturers listed at

WINDOW-BLIND NEWS



A magnetically controlled blind in a double-glazed window has been developed by Hunter Douglas, and is available as a complete window unit. Since no outside mechanical connection is needed to operate the blind, there are no holes in the glass. You can get the blinds in both horizontal and vertical styles.



Slimshade, a narrow-slat blind in Pella's double-glass insulated windows, is controlled by a dial in a corner of the window. The exterior pane is fixed; interior one removes for cleaning. A $2\frac{1}{2}$ x 5-ft. window with Slimshade sells for about \$250. Solar-heat gain in summer is cut by 82 percent, the maker claims.



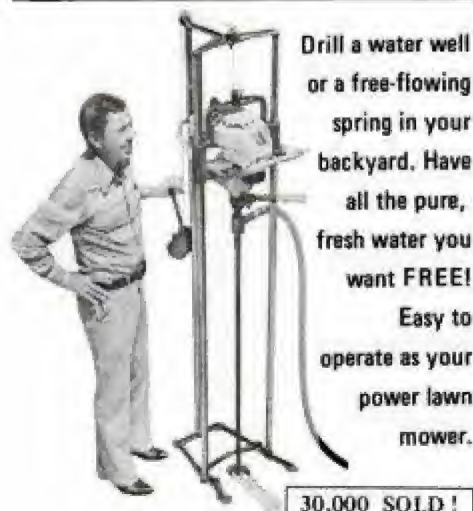
Thermocell insulating window blind, with flexible honey-comblike structure (see detail), opens and closes like an accordion. Dead air spaces in cells give R-values of about 2.5 for the transparent finish, 4.5 for the white and 6 for the chrome finish shown, reports the manufacturer, Thermal Technology.

Retracted, each foot of blind compresses into a $\frac{1}{4}$ -in. space. Blinds will sell this spring for about \$4 per sq. ft.



The Ready Made blind by Levolor in alabaster or white costs one-third less than the maker's custom blinds. A 30-in.-wide blind sells for \$25 to \$36 depending on the retailer. The blinds come 23 to 72% in. wide and 64 in. long. You adjust the length by removing the slats. A patio door double blind is also available.

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the end of this story for further information and specific pricing.

Federal tax credit not given

As this is written, insulating shades and shutters, and other movable window insulation do not qualify for a federal tax credit, as do certain other energy-saving products such as insulation, storm windows and solar collectors. According to the Internal Revenue Service, government specifications require that an energy-saver be installed permanently.

However, the encouraging news is that the IRS is taking a hard look at its rules and, may make an adjustment in the next 12 months. Meanwhile, in a number of states (California, for example) state tax credits are offered for movable insulation. Call your state energy office for more information.

Cost-effective placement

If you live in a house with single-glazed windows and where no window or door is protected by storm sash, insulation over every opening would slash fuel bills. But even in this extreme example, a combination of glazing replacement/addition and adding less expensive window treatments to strategic windows not only would prove much less costly than adding storms to all of your windows but would also significantly reduce your fuel bills.

Architect William K. Langdon, author of *Movable Insulation* (Rodale Press), emphasizes that to save money you can be selective in treating windows. To save money, limit window insulating materials to the north openings, and possibly to the west openings, or on the side prevailing winds blow in winter.

Limiting the use of movable insulation makes good sense especially when your home is already tightly sealed and protected at windows and glass doors with at least double glazing, or possibly triple glazing. Then heat loss through windows (minus normal heat gain on sunny winter days) accounts for less than 20 percent of the total loss.

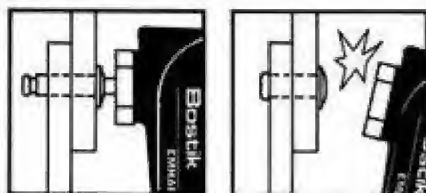
Another saving is made by *mixing* the various types of movable insulation. Save the more expensive, high R-value treatments for the coldest sides of your house. On the less vulnerable sides, lined draperies pulled over the windows at night could do the trick.

In those states subjected to more summer than winter, an exterior treatment such as shutters, awnings or screens can be more effective than movable insulation indoors. To save money along the southern belt or in other areas having hot summers, consider installing insulation on south and west windows.

The other side of cost effectiveness,
(Please turn to page 136)

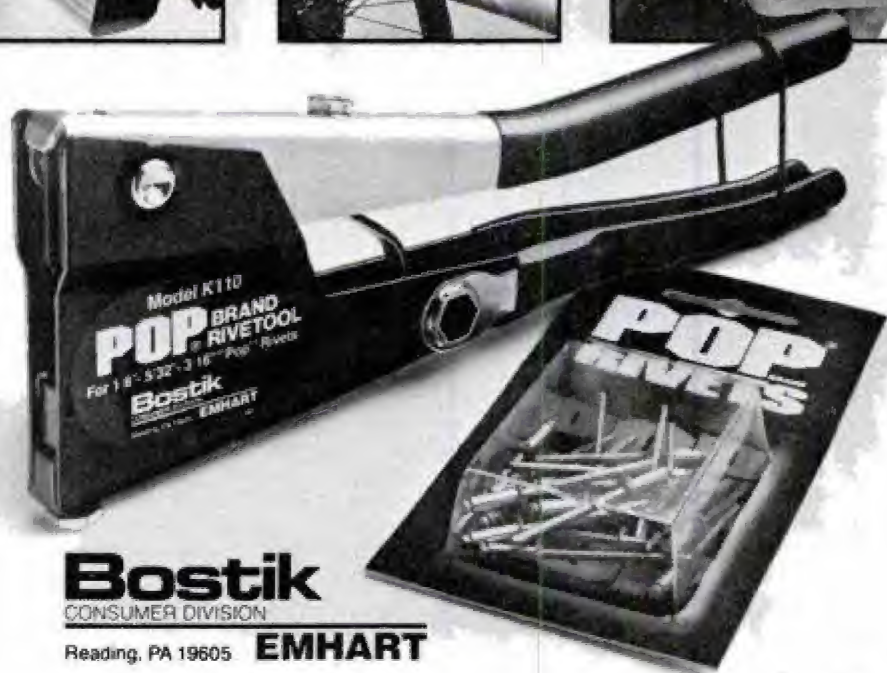
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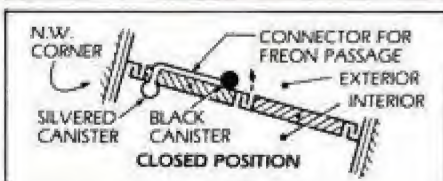
(Continued from page 134)

however, is creature comfort. On a cold winter evening, sitting alongside a window protected with a high-R shutter is downright comfortable. When that's vital to you and your family, budget worries evaporate.

When you begin shopping for these items, you'll discover that 1. distribution is spotty and 2. some makers will claim their product not only blocks heat loss or gain through windows, but seals up losses by infiltration through cracks around the window. Architect Lang-

don, with no profit ax to grind, believes that infiltration ought to be plugged normally with such items as caulk, weatherstripping, foam and fiberglass insulation. "Movable insulation should protect the glazing, period," he emphasizes.

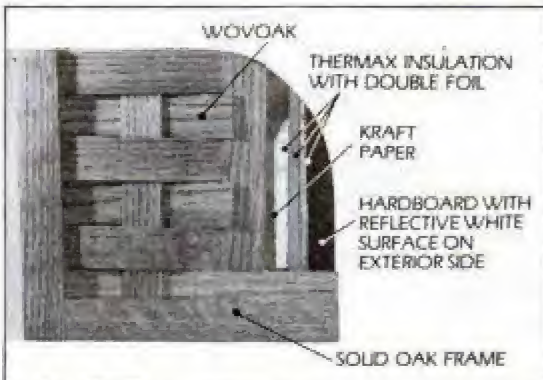
No one has to tell you energy conservation is a serious matter. Your utility and/or fuel bill makes you aware of this every month. However, movable window insulation is one more effective plug in the energy wall. **PM**



The Skylid by Zomeworks lets sun in skylight during the day, seals it against heat loss at night automatically. Panels open and close by the weight of Freon shifting between two canisters (there's only enough Freon to fill one), one on the room side and the other facing the skylight. Freon always moves to the cooler container. The system has a manual override. Panels have an R-value of 3 to 5. A unit for a 48 x 54-in. opening weighs 70 pounds and costs \$550.



The Window Seal System by Graber is a shade made with five layers of fabric that produce an R-value of 3. White acrylic on the outside reflects the sun. Quilted polyester in brown or oatmeal faces the room. Shades come with vinyl side tracks, cornice and installation instructions. A 3 x 5-ft. shade is approximately \$98.



Interior shutters of FTR's Wovoak for windows and patio doors provide an R-8 insulation value when Thermax insulation is used, and an R-4.8 value when fiberglass is substituted. Single panels and bifolds are available. The price of a typical 3 x 5-ft. window is about \$286 for a single bifold with a Thermax core. The shutters are shipped fully assembled. You simply install them.



Plastic film sheeting held by transparent tape to the window casing cuts air infiltration up to 97 percent, says 3M, its maker. A hair dryer eliminates wrinkles. One Window Insulator kit (\$4.50) has tape and plastic to cover a 3 x 5-ft. window.

Window Treatment Makers

Following is a partial list of movable insulation manufacturers. Several are small and their lines of distribution are not firmly established. Thus, you may find only a few of the products mentioned in your local home center. However, except for products sold as part of a completed window, most firms listed will ship f.o.b. from the factory. Write for information.

Blinds, exterior

Nichols-Homeshield Inc., 1000 North Harvester Rd., West Chicago, Ill. 60185

Blinds, interior

Levolor Lorentzen Inc., 1280 Wall St. West, Lyndhurst, N.J. 07071

Thermal Technology Corp. of Aspen Inc., 600 Alter St., Atlas Industrial Park, Broomfield Colo. 80020 (Thermocell insulating miniblinds)

Plastic insulating film

3M Household and Hardware Products Div., Bldg. 223-4S, 3M Center, St. Paul, Minn. 55144 (3M Window Insulation Kit)

Stanley Hardware, Div. Stanley Works, 195 Lake St., New Britain, Conn. 06050 (interior and exterior applications)

Shades

Appropriate Technology Corp., Old Ferry Rd., Brattleboro, Vt. 05301 (Window Quilt)

Graber, Graber Plaza, Middletown, Wis. 53562

Jaksha Solar Systems, 5900 Deerhaven Rd., Lincoln, Neb. 68516 (Insulider)

Thermal Technology Corp. of Aspen Inc., 600 Alter St., Atlas Industrial Park, Broomfield, Colo. 80020 (Insulating Curtain Wall, electrically operated; Super Shade, manually operated)

Warm Window, 3288 Lake City Way N.E., Seattle, Wash. 98115

Shutters

Columbia Moulding Extrusion Div., Jim Walter Plastics, 4747 Hollins Ferry Rd., Baltimore, Md. 21227 (Thermax)

FTR-Wovoak, 5725 Arapahoe, Boulder, Colo. 80303

Homesworth Corp., 18 Main St., Yarmouth, Me. 04096 (Sunsaver)

Shutters Inc., 110 East Fifth St., Hastings, Minn. 55033 (Thermafoid)

Thermal Wall Insulating Shutters Inc., R.D. 1, Box 482-A, Voorheesville, N.Y. 12186

Zomeworks Corp., 1221 Edith Blvd. N.E., Albuquerque, N.M. 87125 (Skylid for skylights)

Solar screens

Phifer Wire Products, Box 1700, Tuscaloosa, Ala. 35403

J.P. Stevens & Co Inc., 1185 Avenue of the Americas, New York, N.Y. 10036

Complete windows

Rolscreen Co., Pella, Iowa 50219 (Pella Slimshade)

Window Makers using magnetic blind:

(Magnetically-controlled between-glass blind made by Hunter Douglas Inc., 87 Route 17, Maywood, N.J. 07607)

Efco, 200 West Dairy St., Monett, Mo. 65708

Enviro-lite Enterprises, 6 Carol Ave., West Haverstraw, N.Y. 10993

Sun Windows Inc., 1515 East 18th St., Owensboro, Ky. 42301

Note: Many shades and shutters in a slider design will adapt to skylights.

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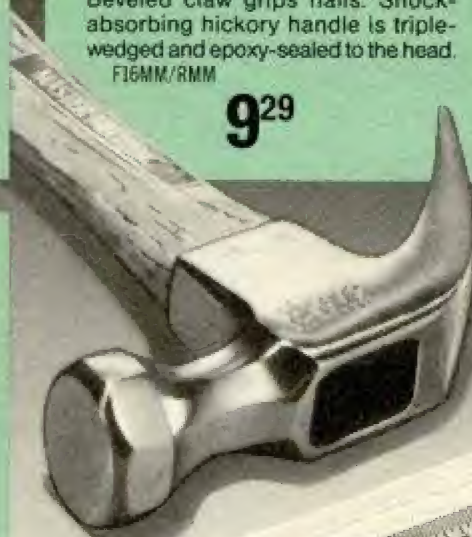
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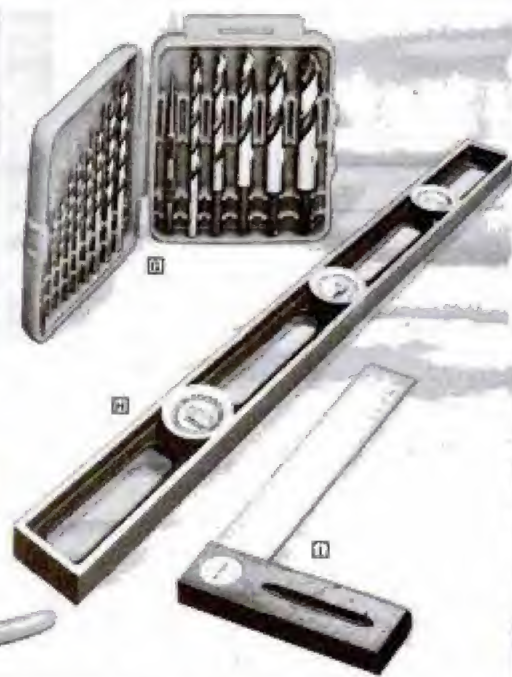
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H **MASTER MECHANIC®** 28" Level has six unbreakable vials, 4 plumb and 2 level, sealed against moisture and dirt in rugged cast aluminum frame. 10122

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I **MASTER MECHANIC®** 8" Try Miter Square has rust-resistant copper-clad blade, top edge reads inches, lower in metric. 6" mahogany handle. 10191

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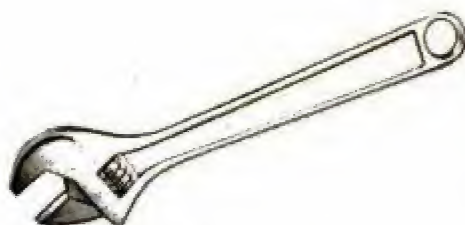


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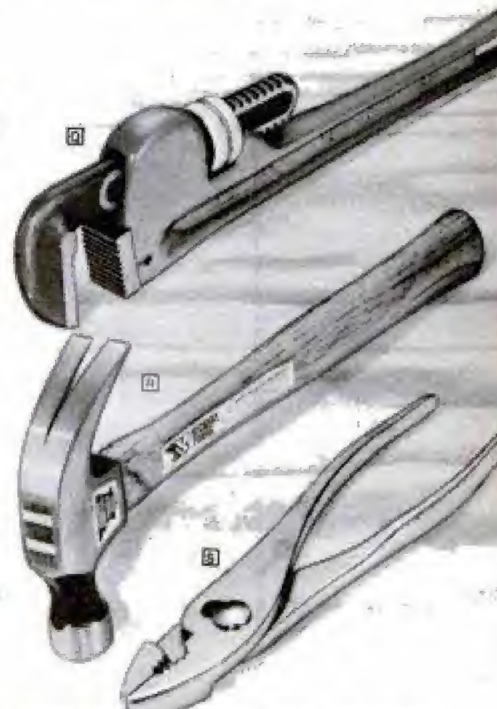
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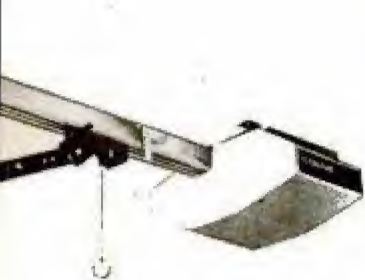
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GREAT NECK® 7-in-1 Hole Saw fits any electric drill, lathe, drill press. Furnace steel blades cut 1-2 1/2" holes through 3/4" thick wood or plastic. HC7C **3⁹⁹**



GREAT NECK® 10" Spiral Screwdriver with 6 different bits. 1 is attached, with 3 drill points and 2 screwdriver bits stored in the handle. 97AC **5⁵⁹**



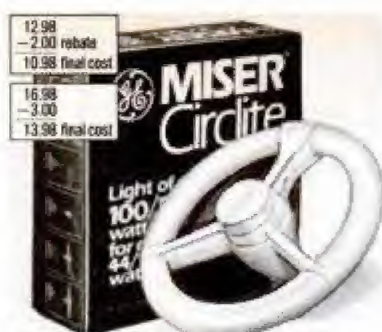
GENIE® Garage Door Opener. Deluxe screw drive, automatic light, Cryptar® II control. Rails snap together, it's easy to install. GS850 **179⁹⁹**



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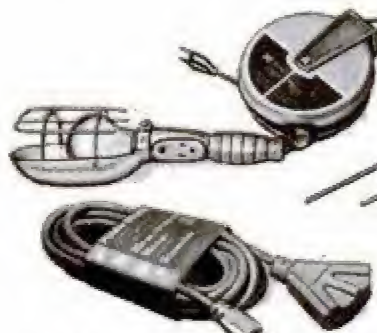
G SKIL® Cordless Screwdriver recharges in 3 hrs., powerdrives and removes up to #5x1 1/2" wood screws. With tips and charger. 2000 **29⁹⁹**



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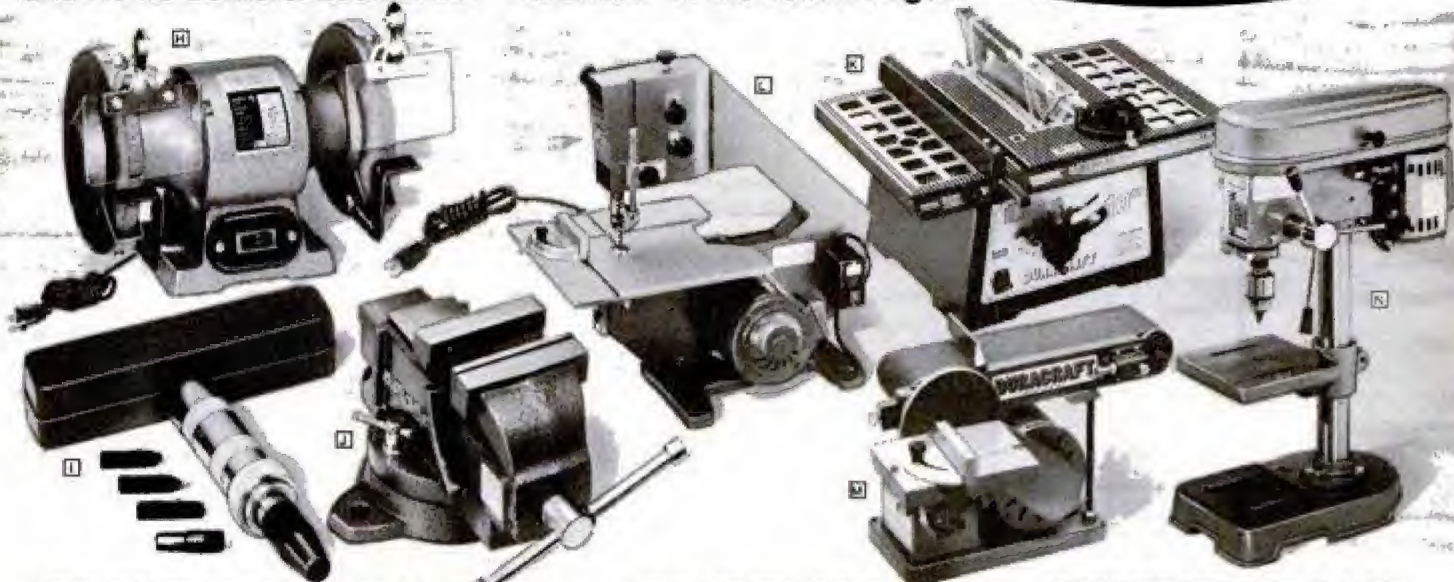
TRUE VALUE® Royal Roll® Casters in handy 2 pack, ball bearing swivel for easy movement at any angle. 2" dia., plate or stem fastener. B84B49R/94 Pair **7⁸⁸**



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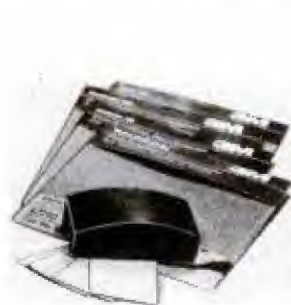
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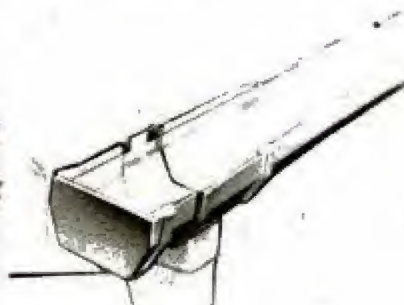
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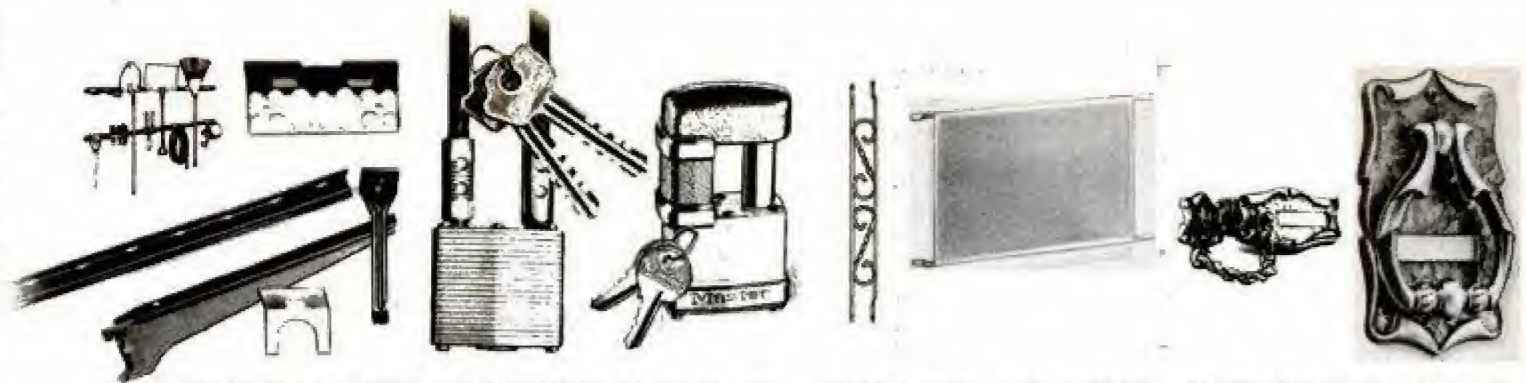
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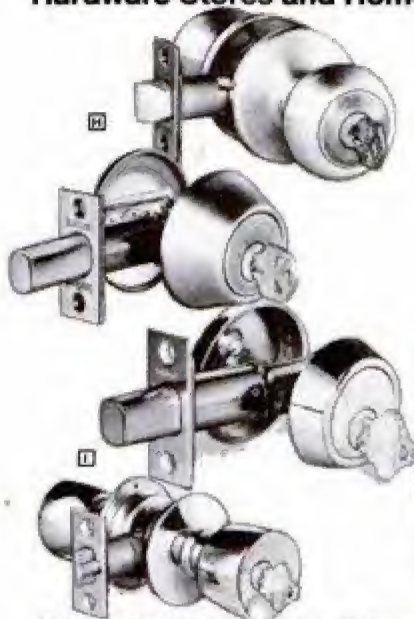
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8-page tear-out section.

Build Your Own Pantry On Wheels

BY WALTER ALAN KERR

After repeatedly digging into our deep, dark pantry to retrieve a bottle of soy sauce or a can of tomato paste, I designed these roll-out racks of shelves. The racks stand side by side and are mounted on rollers. When one of the racks is pulled out, all items on its shelves are visible and accessible.

The racks are easy-to-build, $\frac{3}{4}$ -in.-plywood frames, assembled using butt joints. Cleats at the joints serve as

strengtheners. The $\frac{1}{2}$ -in.-plywood shelves provide further rigidity.

The racks move on appliance rollers. These multiwheeled plastic or aluminum supports are used for moving refrigerators and stoves. You can purchase them at hardware and discount stores or by mail from Sears. You'll need one set for each rack.

I built some of my prototype racks less than 8 in. wide. These narrower

racks require retainers (lips) on both sides of the shelves. I used venetian blind slats as retainers.

You can roll out the racks easily with a brass pull, positioned slightly above waist height on the side of the rack facing out.

To assemble and finish the racks, you'll need a hammer, drill, screwdriver, nailset, paintbrush and some 80- and 120-grit sandpaper. A corner clamp is also handy. Use the clamp at each shelf corner to hold the parts in place while you attach them with nails or screws.

To determine the number and size of racks your pantry can accommodate, measure the depth of the pantry or closet and the height and width of the opening. Allow $\frac{1}{2}$ to 1 in. clearance at the sides and between racks. Racks at
(Please turn to page 146)

Nearly every size package is visible and readily accessible in this pantry on wheels (left). Labeling each rack with its contents makes locating items even easier. On racks 8 in. or wider (rack, far left), appliance roller mates can be extended the same length and fastened to a rack. On narrower racks, stagger rollers.



Before building the pantry on wheels, the 30-in.-deep pantry (above) was too cavernous to display its contents. You had to take everything off the front of a shelf to locate items pushed to the back.

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PANTRY ON WHEELS

(Continued from page 145)

least 8 in. wide accept the rollers best, since both mates of a set can be extended the same length. Subtract the height of the appliance rollers from the height of the opening to get the maximum height of the rack sides.

Next, decide upon the number of shelves you would like per rack. Either draw a rough sketch to scale for each rack, including the shelves, or use the dimensions on the drawing below, if your pantry can hold this size rack. From the drawing, make a materials list you'll need when purchasing lumber and hardware.

Assembly and painting

Cut the parts to size, then sand them smooth, dusting with a clean brush between steps.

Lay out the rack sides. Prebore the cleats and, using a corner clamp, fasten them to the sides with glue and screws. Fasten the top and bottom pieces to the cleats with glue and nails. Then hammer finishing nails through the rack sides into the ends of the top and bot-

tom. Set nails and fill holes with wood putty.

Prime and paint the shelves with a semigloss plastic or acrylic latex paint before installing. You can hang each shelf to dry by a string fastened to a small nail driven partway into one end. Then prime and paint the rack.

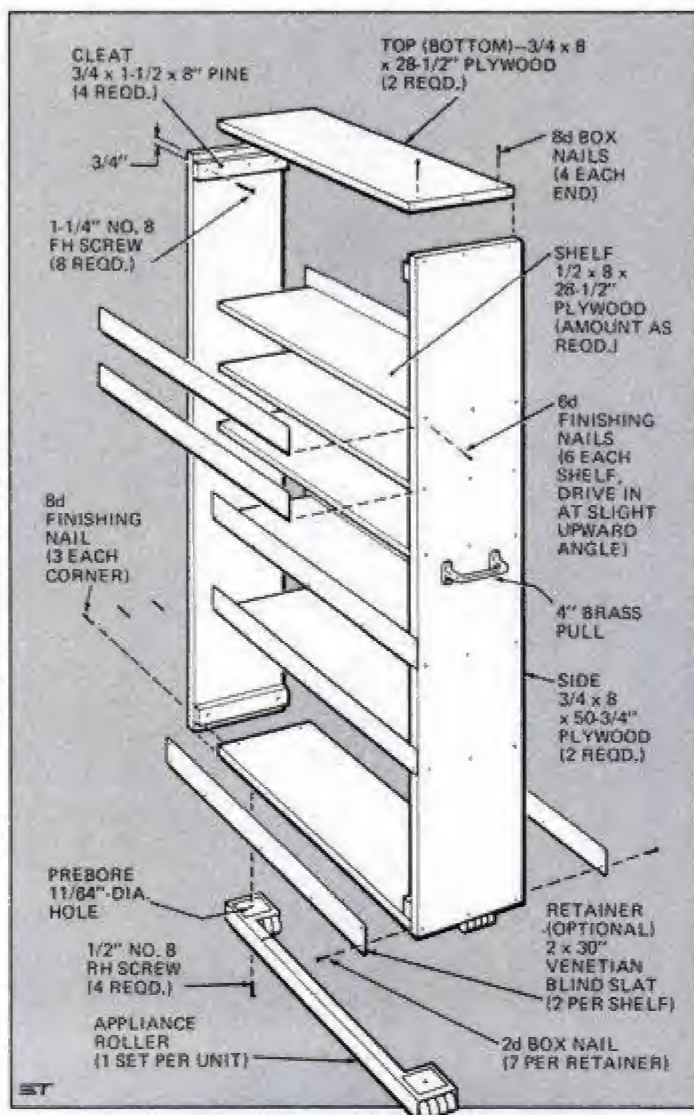
After the paint is dry, lay the rack on its front edge and measure and mark shelf placement. Then, stand each shelf on edge within the rack, secure it with the corner clamp and drive nails to fasten it in place. Set the nails and fill the holes.

Make retainers of venetian blind slats nailed to rack sides and shelf bottoms. Or use 1/4-in.-thick lattice.

If possible, snap out the rollers and shafts from their housings. Position the housing on the bottom of the racks so they're within 1/4 in. of the edge. Bore a small hole in each end and secure with screws. Snap the rollers and shafts back in and stand the rack upright.

Touch up nail holes with paint and attach the brass pulls. If there is a saddle on the floor below the closet door, remove it, so it won't interfere with the rack's mobility. **PM**

Each unit is a 3/4-in. plywood frame with butt joints. Shelves are 1/2-in. plywood. Appliance rollers allow unit to move easily and the retainers keep items from falling off pantry shelf. A brass pull lets you pull the unit out of the pantry and return it when you are finished.



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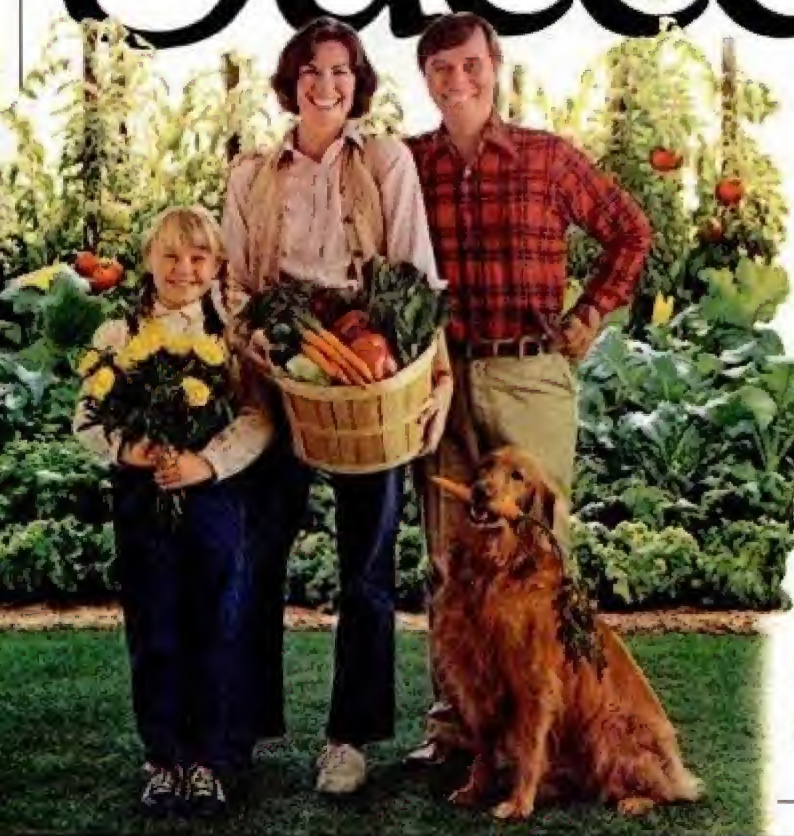
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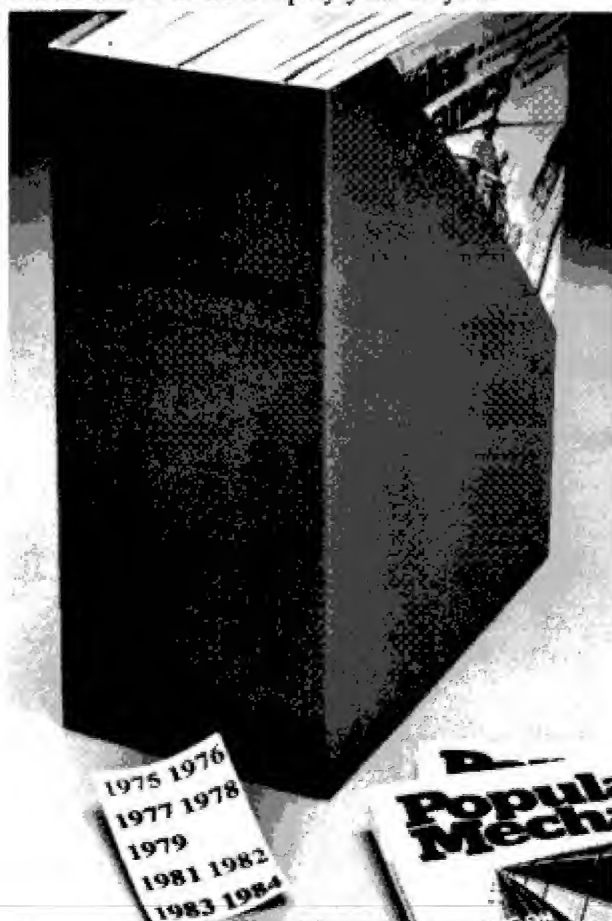
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How To Stop Any Faucet From Leaking

Step by step, here are the repairs for each of the common types of faucets.

BY RICHARD DAY

Photos by the author

The toughest part of fixing a leaking faucet is getting to the job. But you shouldn't put it off. Only one drop a second will waste a shameful amount of water—2,300 gallons a year. And the repairs after a year of dripping will be no easier than they were when you first noticed the leak.

Tools needed for faucet work are a large adjustable wrench, flat-blade screwdriver, Phillips screwdriver and pliers. You may need some special tools for seat work on compression faucets.

Actual steps vary with the type of



If a swing-spout-type kitchen faucet leaks at the spout joint, it probably needs a new O-ring. Remove the spout and retaining parts and take the old O-rings to your plumbing supplier so that they can be matched with a new set.

faucet. Basically, there are two faucet types: compression (washer-type) and noncompression (washerless).

The first step in making repairs on any faucet is to turn off the water supply. If you're fixing just one side—hot or cold—of a dual-handle faucet and

the fixture has handy shutoff valves beneath it, you need turn off only the side to be worked on. Lacking under-fixture shutoffs, you'll have to turn off either the branch water supplies or the house main water shutoff.

To repair any but a tipping-type faucet, discussed later, you remove the handle and take out the faucet's innards. Compression valves on tub/shower controls that leak are fixed similarly to compression faucets.

REPAIRING COMPRESSION FAUCETS



1 To repair a leaky washer-type (compression) faucet, such as this U.S. Brass Ventura, first remove handle and unscrew packing nut with an adjustable wrench. Wrap nut with plastic tape to protect it. Turn nut counterclockwise.



2 With the packing nut off, unscrew the stem by turning it in its "on" direction. You can probably do this by hand, but if the stem should prove to be very difficult to turn, temporarily reinstall the handle to get extra leverage to turn it.



3 A single screw holds the old seat washer to the stem. Remove screw and washer. This assembly uses a Phillips screw. However, most assemblies use a standard slotted brass screw.



4 Lift out the old seat washer and fit a new one the same size into the recess. A worn or grooved washer could have caused the leaks. If the screw is corroded, replace it with a new brass one.

Repairing washer-type faucets

Compression faucets (see drawing, page 150) are inexpensive and common. They also cost little to repair. They leak either at the spout or past the stem. Leakage past the stem can be cured by tightening the packing nut or replacing the stem's rubber O-ring if there is one. Sometimes the faucet's stem packing, if used, must be replaced.

To remove a faucet handle, loosen the Phillips-head screw that holds it to the stem. Sometimes this is located beneath a decorative trim cap in the center of the handle. The cap either unscrews or can be snapped off by prying with a chisel or putty knife.

Handles lift or are pried off of the upper end of the stem. If your old faucets are badly corroded, you may want to replace rather than repair them. Any decorative parts should be padded with cloth or tape before unscrewing them with pliers.

Beneath the removed handle is the packing nut. Unscrew it from the top of the faucet body (see photo 1) to expose the stem. Be especially careful with the plastic parts used on many of today's

(Please turn to page 150)

faucets. Then, by rotating in the "on" direction, you can unthread the stem from the faucet.

If the old faucet stem is badly corroded or worn, you'll want to replace it with a new one. If your dealer does not have a match for your old one, ask him to order one. If the stem is dirty, clean it with fine steel wool. Discard the old, hardened packing if there is packing on the stem.

At the lower end of the stem, you'll see the seat washer. If it is squeezed flat or has a groove from being closed tightly against the faucet seat, it likely is the cause of the drip. It should be replaced. So should one that looks ragged or is hard with age. If the old seat washer screw is damaged, replace it with a new brass one.

You can often make a temporary seat washer repair by turning the old washer over and using its backside as the working surface. However, follow this with a more permanent repair as soon as possible.

It's not easy to tell much about a faucet seat by looking at it. For best results, replace or reface the seat as shown on this page. In any case, a compression faucet that requires frequent washer replacements is a candidate for seat rejuvenation.

More than likely a new seat washer is what's needed. Be sure to get one of the same size and shape—flat or beveled—as the old washer. Faucet seat washers come in sizes from 1/2 in. to more than 1 in. (rare). They're given nominal designations. However, the best way to get the size you need is to match the old washer with a new one.

Long-lasting swivel-head seat washers do away with the friction between washer and seat upon closing. The washer meets the seat in a straight-down action rather than with a twist. To install, you drill out the threads of the old stem washer screw and push the swivel-washer into the hole. The washer screw isn't used. If the new swivel-washer is too large to fit into the recess for it, file off the edges of the recess, leaving the stem flat. In any case, follow directions with the swivel-washer you use.

Some compression faucets made by American-Standard and Kohler (Valvet) use a combination replaceable washer-seat faucet unit. With unit replacement, all wearing parts are renewed: stem, washer, seat and housing. Naturally, the cost is more than for just a seat washer or seat. But the job's easy.

A faucet that chatters when opened
(Please turn to page 152)

COMPRESSION FAUCET MAINTENANCE



To install a long-lasting swivel-seat washer, file the stem edges if needed, drill out the screw threads and insert the swivel-washer prongs into the stem opening. Swivel washers do not grind closed on seats; thus wear is reduced.



Most faucets have replaceable seats. A seat with a square or hex opening is replaceable using a faucet-seat tool. This one has various square and hex heads.



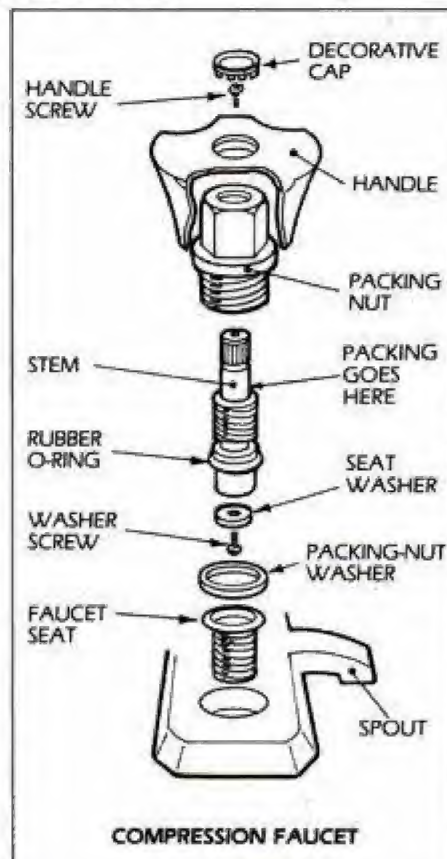
Before you reassemble the faucet, install new packing on stem (if it is used). With flexible packing, install three turns; with stiff packing, a single turn will do it.



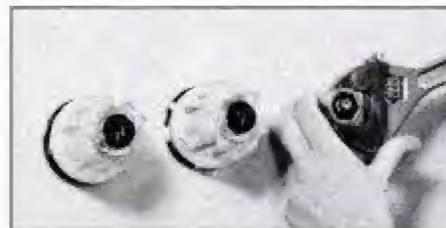
Modern washer-type faucets use O-rings rather than packing to eliminate stem leaks. If there is an O-ring (arrow) on the lower end of the stem, the faucet does not require any packing. See below.



If the faucet leaks water beneath the handle it's another sign the O-ring should be replaced. In making the replacement, carefully roll on the new O-ring to keep it from stretching out of shape.



If the washer requires frequent seat washer replacements, the seat is probably damaged. You can correct this by dressing the seat with a seat-refacing tool. This one by Push-Tite mounts in a hand drill. Follow directions furnished.



To work on compression tub/shower faucets, you may need a set of special socket wrenches (about \$10). These reach behind the wall to remove the packing nuts so you can remove the long stems. With the stem out, tub/shower washer service proceeds as with smaller faucets.

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'83 HOME IDEAS GUIDE

(Continued from page 150)

part way is telling you that it has a loose
seat washer or seat.

Seat service

Faucet seat-dressing is done with a
low-cost tool. You can get one where
plumbing supplies are sold. The Push-
Tite (Push-Tite Mfg. Co., 215 South
Highway No. 7, Olathe, Kan. 66061)
uses a grinding stone rather than a se-
rated cutting wheel. It does a smoother
job of seat-dressing. Follow the manu-
facturer's directions for whatever tool
you use. Be sure to blow out the chips
after you finish; wear eye protection
when you do.

It may be just as easy to replace a
faucet seat as to dress it, provided it's
the replaceable screw-in type of seat. If
it has a square or hexagonal hole in the
center, it's replaceable. You'll need a
valve-seat removal tool with square and
hex ends. The seats thread out by turn-
ing counterclockwise. Show the old seat
to your plumbing supplier and ask for a
new one just like it. It helps to know the
make of faucet. Put a little silicone rub-
ber sealant such as bathtub caulk or
pipe joint compound on the threads of
the new seat before threading it in.

Before reinstalling the stem it's a
good idea to put some petroleum jelly

REPLACING A DIAPHRAGM



A faucet with a diaphragm can last for
years without leaking. But if yours leaks
around the stem, you must replace the
diaphragm. To get at it you must first
remove the faucet stem.

or silicone grease on the threads to
smooth faucet action. Use of nylon-cov-
ered or graphite-impregnated packing
helps, too. Avoid the temptation to use
ordinary string for packing. It won't
last. Give the packing nut half a turn
past hand-tight.

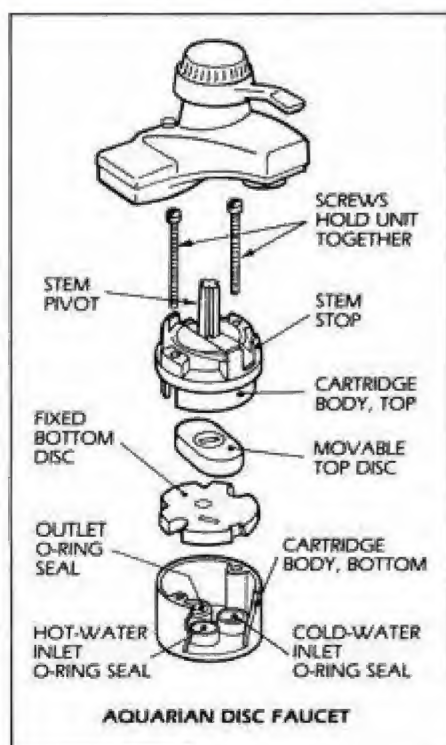
Repairing washerless faucets

Leaks in washerless faucets are not
common. When repairing one, it helps
to have the manufacturer's instruction
sheet. You can probably get one by
sending a faucet description to the
maker.

REPAIRING A DISC FAUCET



American Standard's Aquarian single-
handle disc faucet has a replaceable disc
unit that changes all moving parts. To
change discs, remove the handle and two
screws. Then lift off the old disc (left).



To repair common two-handle disc fau-
cets, as this Delta Delex, remove handle
and lift disc assembly up and out, pulling
it with pliers. Adding a new assembly
replaces moving parts of the faucet.



At bottom of the Delex disc cavity is a
tiny rubber seat on a spring. If changing
discs doesn't stop a leak, pick out the disc
and replace the seat and spring.

The diaphragm-type faucet is most like a compression faucet. It puts a rubber diaphragm between the swiveling spindle and a fixed seat, making a straight-down closing action. American Standard's Aqua-Seal faucet works like this (see top photo, page 152).

Disc-type faucets (see drawing and photos, page 152) are available in both single- and dual-handle. Discs with holes or slots are rotated, one on the other, so that the openings line up (water flows) or misalign (water is off). O-rings may be used to prevent inter-disc leaks. While there is some friction between the discs as they move, they are made of hardened material to take it without wearing much. Delta's Delex, U.S. Brass's Aqua-Line series, American Standard's Aquarian, most newer models of Universal-Rundle/Sears, and many other faucets use discs. Disc faucets are fixed simply by replacing the seats (if the unit has them) or else by replacing the entire disc assembly. On the American Standard Aquarian with ceramic discs, look for dirt between the discs or worn rubber O-ring disc assembly seals.

Repairing ball-type faucets

The single-lever ball-type faucet such as those made by Delta and Peer-

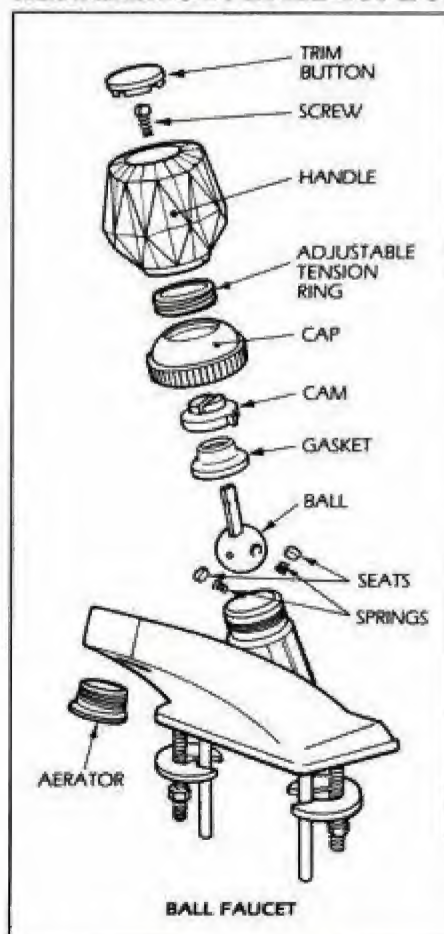
less (see drawing and photos below) routes the water through holes in a brass or plastic ball worked by a single handle. Spring-loaded soft rubber seats on the hot and cold sides contact the ball. These let water through only when they're aligned with a hole in the ball. A rubber gasket with cam and adjustable tension ring seals the ball from leaking to the outside at the handle.

Ball-type faucet repair kits come several ways: seats and springs only; cam, seats and other parts; and all parts including the ball. The major ones contain a faucet tool; the spanner wrench on one end turns the adjusting ring, and the hex wrench on the other end tightens the setscrew on the faucet handle. If one of these faucets leaks just beneath the handle, often removing it and slightly tightening the adjusting ring will cure this.

If the faucet leaks at the spout, it needs new rubber seats and springs. Unscrew and remove the cap assembly. Pull the ball stem up to lift out the ball and cam. Then take the rubber seats and springs out of the faucet body. Install new springs and put the new rubber seats down over their tops. Reassemble the ball and cam, making sure the slot in the side of the ball and

(Please turn to page 154)

REPAIRING A BALL-TYPE FAUCET



1 Whether used for tub/shower, sink or lavatory, ball-type faucets are serviced alike. First, remove the bonnet (cap) assembly with water-pump pliers, protecting chrome with tape.



2 Pull out ball, bringing the cam with it. If ball appears worn or corroded, buy a replacement.

3 A ball faucet that leaks at the spout needs new seats and springs. Pick out the old ones with long-nose pliers. Replace with new ones from a kit.



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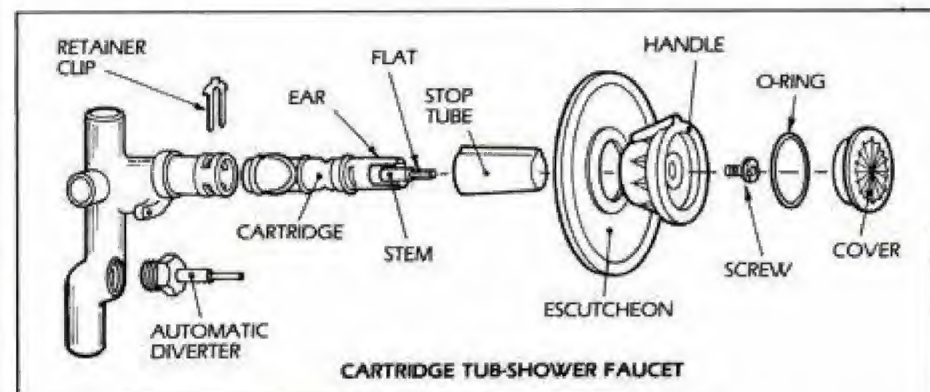


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REPLACING A FAUCET CARTRIDGE

The moving parts of some cartridge faucets like this Moen single-handle are in one long and slim replaceable cylindrical case. To remove this cartridge pry out a retainer clip hidden under or behind the handle with a small screwdriver (near right). If a unit leaks, it's best to replace the cartridge. Use the handle to remove and replace cartridges on two-handle faucets (far right). The quarter (foreground) is a handy tool for turning the slotted cartridge retainer.



the pin in the faucet body engage. The cam also must fit into a notch in the body. Install the cap and adjust the ring. If you have trouble stopping leaks around the ring, then the cam with gasket should be renewed as well.

Repairing a cartridge faucet

Cartridge faucets (see drawing and photos above), such as those made by Moen and Kohler, have a single moving part: the stem. It selects the water temperature as well as controls volume. All wear occurs inside the cartridge. If this type of faucet ever leaks, the cartridge can be replaced. Pliers may be needed to lift the Moen cartridge from the faucet against O-ring tension. The Kohler Centura system uses a three-part cartridge consisting of valve sleeve, body and noncorrosive cam. The cartridge lifts out once the single-handle faucet is taken apart.

In the Moen system two identical cartridges—one brass, one plastic—fit all single-handle faucets and valves made after 1959. The plastic ones are best for hard-water use as they don't tend to collect scale. A third Moen cartridge fits only its two-handle lavatory faucets.

Moen and a few other faucets use retainer clips to hold the cartridge. On some faucets the clip may be seen at the rear of the faucet just beneath the handle. On others the handle has to be

removed first. A tube beneath the handle may hide the retainer clip, so simply lift that off. A few makes have two retainer clips, the second by the handle. Pry the retainer clip out with a small screwdriver or long-nose pliers; then pull out the cartridge with pliers.

Install a new cartridge with arrow, spot or other mark aimed up. Then re-install the retainer clip, ring and handle.

The tipping-valve faucet used in some older models of Universal-Rundle/Sears uses a single handle with cam at the rear of the unit to push hot and cold water tipping valves off-center to control water. The parts are accessible through plugged openings on each side of the body.

The wearing parts are fully replaceable. They come in a kit from Sears with a complete set of parts for each side of the valve. To get the old ones out, remove the spout-retaining nut and lift off the spout and escutcheon to expose the faucet body. Remove brass plugs on both sides of the body and take out strainer, spring and tip-valve stem. Unscrew the valve seat and replace parts with new ones from the kit.

FM

FAUCET REPAIR INFORMATION

Gerber Plumbing Fixtures Corp., 4656 West Touhy Ave., Chicago, Ill. 60646, Brochure: "Tip From Your Plumber," 25 cents.

U.S. Brass, 901 10th St., Plano, Tex. 75074, attention: Advertising Manager. Free brochure: "Faucet Replacement Guide."



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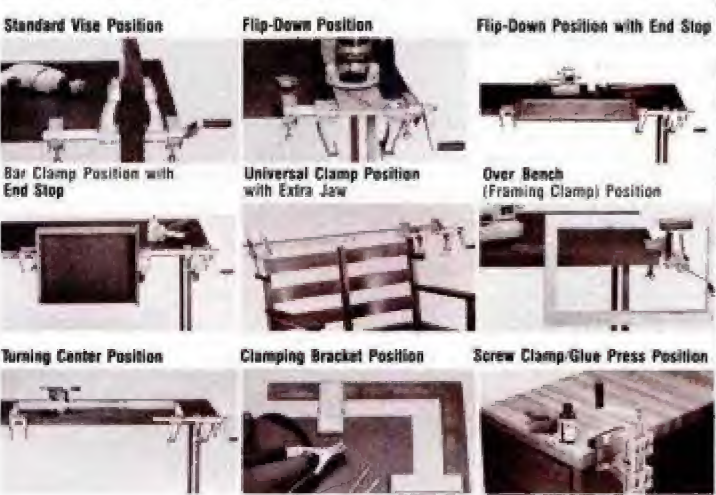
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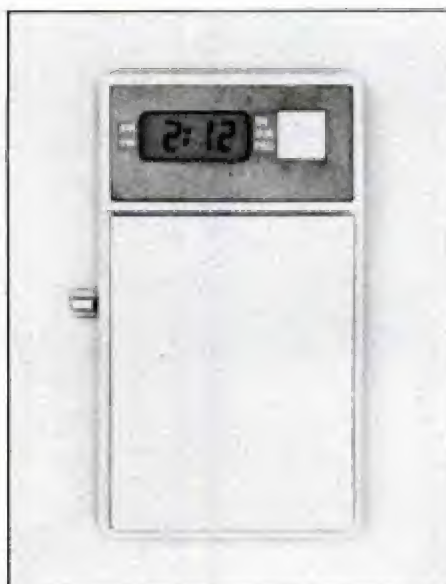
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\$200 to \$450 and are sold by Old Jacksonville Ceiling Fan, Nichols-Kusan Inc., Box 1191, Jacksonville, Tex. 75766. For the location of the dealer nearest to you, call 1-800-527-8419; Texas residents should call 1-800-442-8955.



Armstrong captures the natural look of rush-fiber matting in its new Sundial Solarian line of vinyl flooring. The realistic rustic weave pattern is achieved by a process that combines photography and printing. A no-wax finish is used to help protect the pattern and make the flooring easy to keep clean. The vinyl flooring is available in 6- and 12-ft. widths and costs approximately \$11.50 per sq. yd. This price does not include installation. It is manufactured by Armstrong Inc., Box 3001, Lancaster, Pa. 17604.

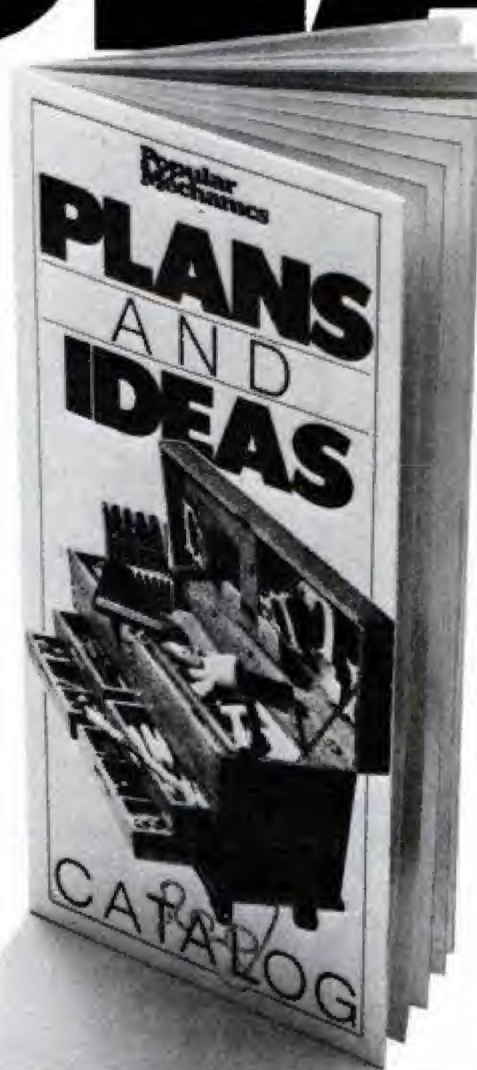


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KitchenAid's model KCS-200 (\$529) trash compactor features two front panels with the flip side of each a different color: almond/white or wheat/black. Each panel can be easily reversed or interchanged with the other. Additional features include: loading small items through the litter bin door while the unit is operating, a 1.7-cu.-ft. trash drawer and a 1/4-hp motor which is claimed to exert 3,000 lbs. of force. For details, write Customer Relations, KitchenAid Div., Hobart Corp., Troy, Ohio 45374.

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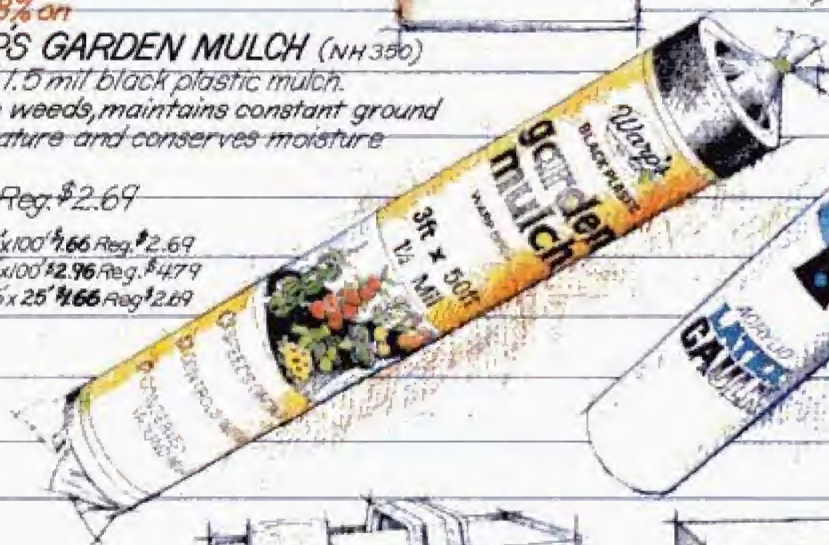
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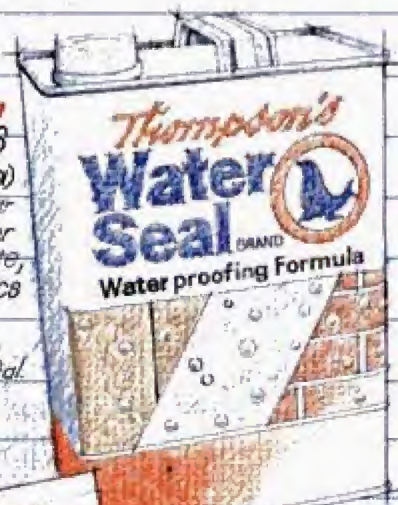
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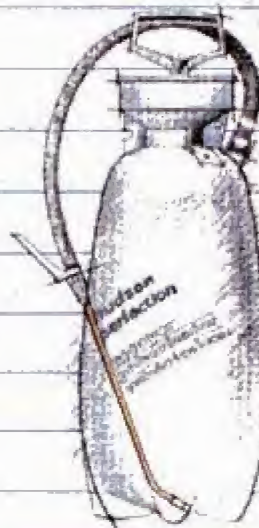
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'83 HOME IDEAS GUIDE

Energy-Savers For Your Home



General Electric's silicone masonry seal repairs cracks in exterior and interior masonry surfaces, such as foundations and fireplaces. It can prevent cold air from escaping during the summer and keep warm air in during the winter. Each 8½-oz. cartridge is about \$5. For more information write to General Electric Co., Silicone Products Div., Waterford, N.Y. 12188.



Conserve energy and water by replacing your existing shower head with the Ultra-Sperse 310 hand-held shower by Minnco. The maker claims a 10-minute Ultra-Sperse shower uses about 4 gal. of water as compared to 30 gal. used by a conventional shower head. The Ultra-Sperse 310 can also be made to work with an existing shower or attached to a tub faucet, with accessory parts available from Minnco. It's \$49.95 plus \$2.50 for postage and handling. Write to Minnco, Box 310, Arnold, Md. 21012.



You can detect tiny, fuel-wasting air drafts around doors, windows, vents and other spots with a Heat Sleuth-100 energy audit tool. Heat Sleuth's temperature sensitivity of 1/25 of a degree can show where to insulate to prevent heat loss. The hand-held unit is powered by a 9-volt battery (included) and operates from 35° to 95°F. Mail \$49.95 to Enertron Corp., 241 Crescent St., Waltham, Mass. 02154.



Myson's Kick-Space fan convector heater is designed for installation in the kick-board space below kitchen cabinets and bathroom vanities. Its space-saving size—3¾ in. high x 16¾ in. deep x 20 in. wide—contains just .076 gal. of water for

quick and efficient heating. The unit comes with a two-speed, remote-control box for approximately \$270. To obtain more information, contact Myson Inc., Box 5025, Falmouth, Va. 22403.

(Please turn to page 162)

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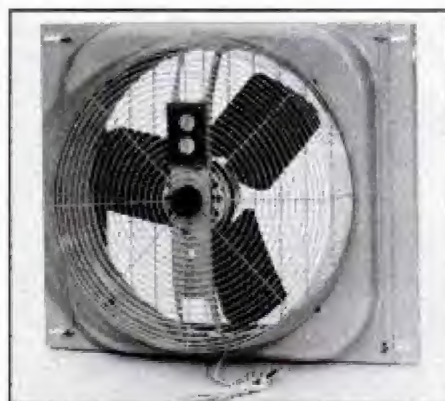
'83 HOME IDEAS GUIDE

ENERGY-SAVERS

(Continued from page 160)



Honeywell Inc. introduces the T8300 Intelligent Recovery offset thermostat, which is designed to be used with heat pumps. A microcomputer allows programming of night setback (which automatically lowers the temperature) during the heating season and day setup (which automatically raises the temperature) during the cooling season to save on both heating and cooling costs. The thermostat costs about \$225. For details, contact Honeywell Inc., 10400 Yellow Circle Dr., Minnetonka, Minn. 55343.



Patton Electric offers a thermostat-controlled window fan for home cooling. The Whole House 20-in. window fan's automatic temperature control shuts down the fan when the house temperature drops to the desired level. The unit is powered by a 1/6-hp motor with three reversible speeds. Its side panels adjust to fit any 27- to 35-in.-wide window opening. The fan is available at hardware stores and home centers for about \$115. It is made by Patton Electric Co. Inc., Box 128, New Haven, Ind. 46774. **PM**

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TERMS BUILDERS USE

Whether you are a once-in-awhile do-it-yourselfer, or an active homeowner who does anything and everything in the area of home improvement, it will pay you to have at least a basic understanding of words and terms that various professionals use. From time to time, *Popular Mechanics* will run a column which zeroes in on those words which are used frequently in its pages. This month's words are those that builders and carpenters use. —John Gaynor

Frost line

This is the depth of frost penetration in the soil. The frost line can and does vary from one geographic area to the next. Check with your local building department to learn the depth for your area. The bottom of the footing must be at this depth.

Footing

This is the masonry base poured on undisturbed soil, in a rectangular form. Located under the foundation wall, a footing's size is based upon the total load (size and dimensions) of the foundation wall and upon the type of soil that will support it.

Foundation

This is either a concrete block or poured concrete wall that is the supporting portion below the first floor of a structure. When a pro speaks of a foundation, he is including that portion below the wall, the footings.

Sill plate

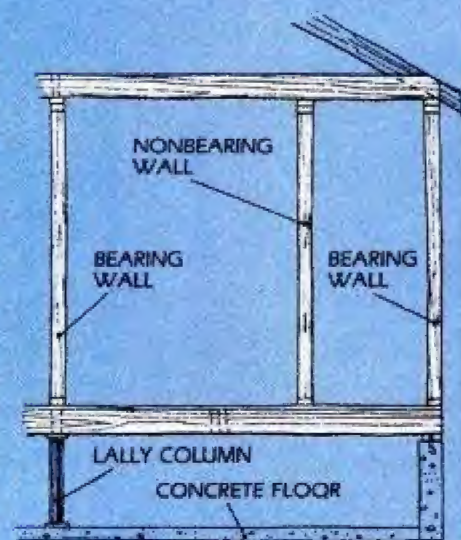
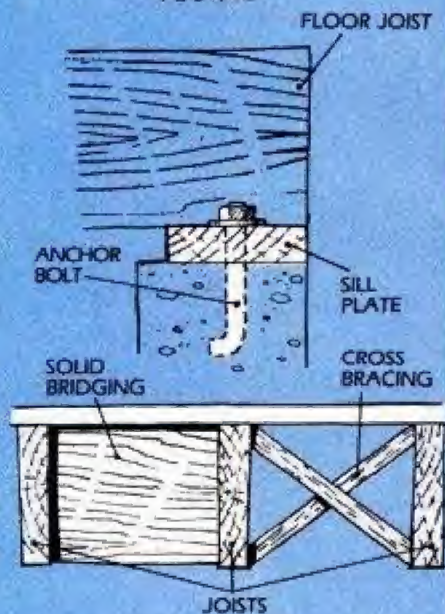
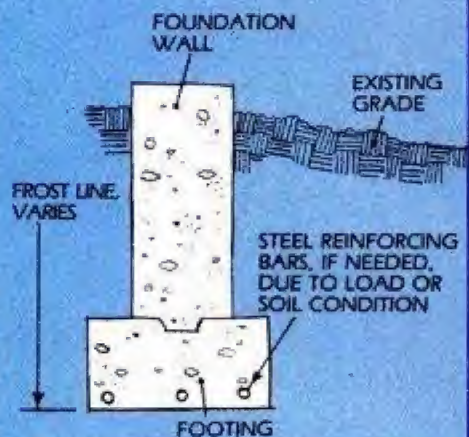
This is the lowest frame member in a structure. The sill rests on and is fastened to the foundation with anchor bolts. The floor joists, in turn, are toenailed to the sill.

Bridging

These are usually small metal or wood members inserted in a diagonal attitude between floor joists at mid-span (and no farther apart than 10 ft.), to prevent joists from twisting and tipping over. Solid bridging—pieces cut from the same stock as the joists—can also be used.

Bearing wall

A bearing wall is one that supports any vertical load in addition to its own weight. In standard frame construction, a bearing wall is generally constructed of 2x4s spaced 16 in. on center, with a doubled-up 2x4 top plate and a single 2x4 sole plate. A bearing wall should never be cut into or removed without first supporting the load above it with the correct new construction. If in doubt, consult a licensed architect or engineer.



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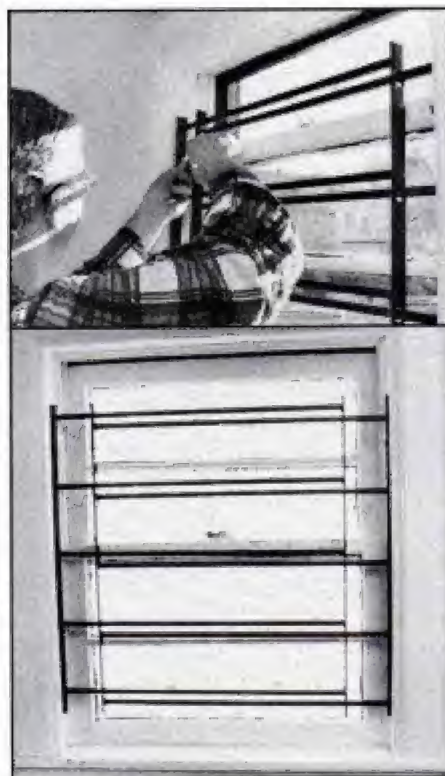

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'83 HOME IDEAS GUIDE

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exit, you can order a Window Gate Kit which converts the unit in minutes. To install the Burglar Bars, hold the unit in position and mark locations for the tamperproof (one-way) mounting screws. Remove the unit, bore the lead holes and complete the installation in minutes. For information, write Vigilante Security Products, Box 37394, Houston, Tex. 77036.—H.W.

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664 A Warehouse Full Of Tools

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665 Beautiful Wood Finishes

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BY RALPH deMASI

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This hoist is as big as we wanted, and so strong that it will probably last a lifetime. The gauge of the steel is thicker than virtually any commercially made units, with the exception of the "monster" cranes used for commercial truck engines. This might be a little overkill for the home mechanic but you can take a certain amount of pride in the fact that this hoist will still be work-

ing long after Brooke Shields is collecting Social Security.

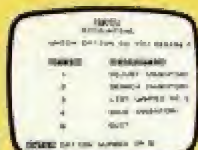
We made it easy to disassemble for storage or transportation by allowing the legs and the mast to slide out of their supports, and by using dowels with cotter pins as the pivot points for the boom and the hydraulic jack. The whole assembly can be taken down in two minutes and laid flat in the back of a pickup for carrying to a work site.

The most critical aspect of this project is the welding. If the welds aren't done properly your hoist will be weak, which could be dangerous. If

(Please turn to page 170)

PM photos: Peter Tenzer
Design and construction:
Ralph deMasi, Tony Assenza

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STATES AND CAPITOLS (#32) Test yourself on the fifty states and their capitals. Three options of review are available. (1) States, you provide capitals. (2) Capitals, provide states. (3) A mix of states and capitals.



PINBALL (#35) Plays like real pinball complete with flippers, bumpers, "nudges," bonus points and more. Uses fast, efficient machine code to choose its moves.



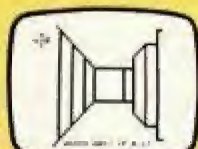
VU-CALC (#11) This program constructs, generates, and calculates large tables for financial analysis, budget sheets, and projections. An immensely powerful analysis chart.



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STOCK MARKET GAME (#27) Bull or bear? This realistic simulation lets you analyze information, buy and sell stocks, take out and pay off loans... and win, if you can accumulate \$50,000 in "The Market."



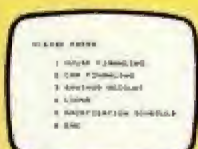
SUPERMAZE (#34) Navigate your way through a three-dimensional maze, with trapdoors, gold bars, marker stones, and compass. Ten separate mazes. Three-dimensional graphics.



CHESS AND CHESS CLOCK (#7) Six levels. All the legal moves including castling and enpassant. Keeps a separate record of plays made for easy reference. Play another opponent or match wits with the computer.



FORTRESS OF ZORLAC (#36) A super fast game in which you are the commander of a fleet of spaceships. Your mission is to rid the galaxy of the dreaded alien, ZORLAC.



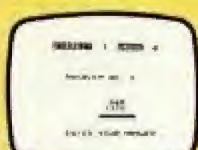
PERSONAL FINANCE PLANNER (#28) Perform calculations, finance a house, a car, keep savings accounts, repay loans and calculate an amortization schedule which can be generated for any of the financial programs.



BACKGAMMON AND DICE (#8) A perfect blend of chance and skill. Uses machine code to choose its moves. Full game including graphics board, rolling dice, and double cube. Play the computer or another opponent.



ATOR THE ABC GATOR (#33) Designed to teach recognition and sequence of the alphabet. Combines computer instruction, music and video games.



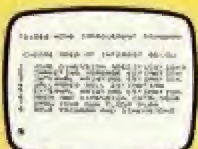
SUPER MATH (#14) Drill yourself on addition, subtraction, multiplication, and division with five levels of difficulty. Each problem graphically depicted.



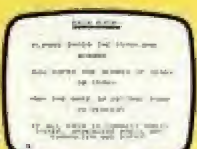
THE CUBE GAME (#9) The cube can be displayed in three views: (1) Solid; (2) Two-Dimensional (unfolded); and (3) See-thru cube (3-D). You start with the cube solved, set it up any way you like, or pick up from a previous session.



SPACE RAIDERS, BOMBER (#5) Times/Tenex version of the popular arcade games full of bombs and rockets and collisions with skyscrapers.



THE HOME IMPROVEMENT PLANNER (#29) Store up to 20 room measurements (length, width, height), compute total area in each (wall, floor), estimate costs of painting, wall papering and carpets and draw house blueprints.



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 16 5x6, 5x8 wheel & tire 32
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ENGINE HOIST

(Continued from page 168)

you've never done any welding, we'd recommend you practice with scrap pieces of metal first. Most arc-welding kits come with instructions which will give you the basics. If you don't feel comfortable with this information in the booklets, look for professional advice.

When you're welding, always wear a full welder's mask, leather gloves, leather apron and long-sleeve shirt.

Stock steel shapes used

Construction is simplified by use of steel shapes normally in stock at local steel distributors. In our case all tubing

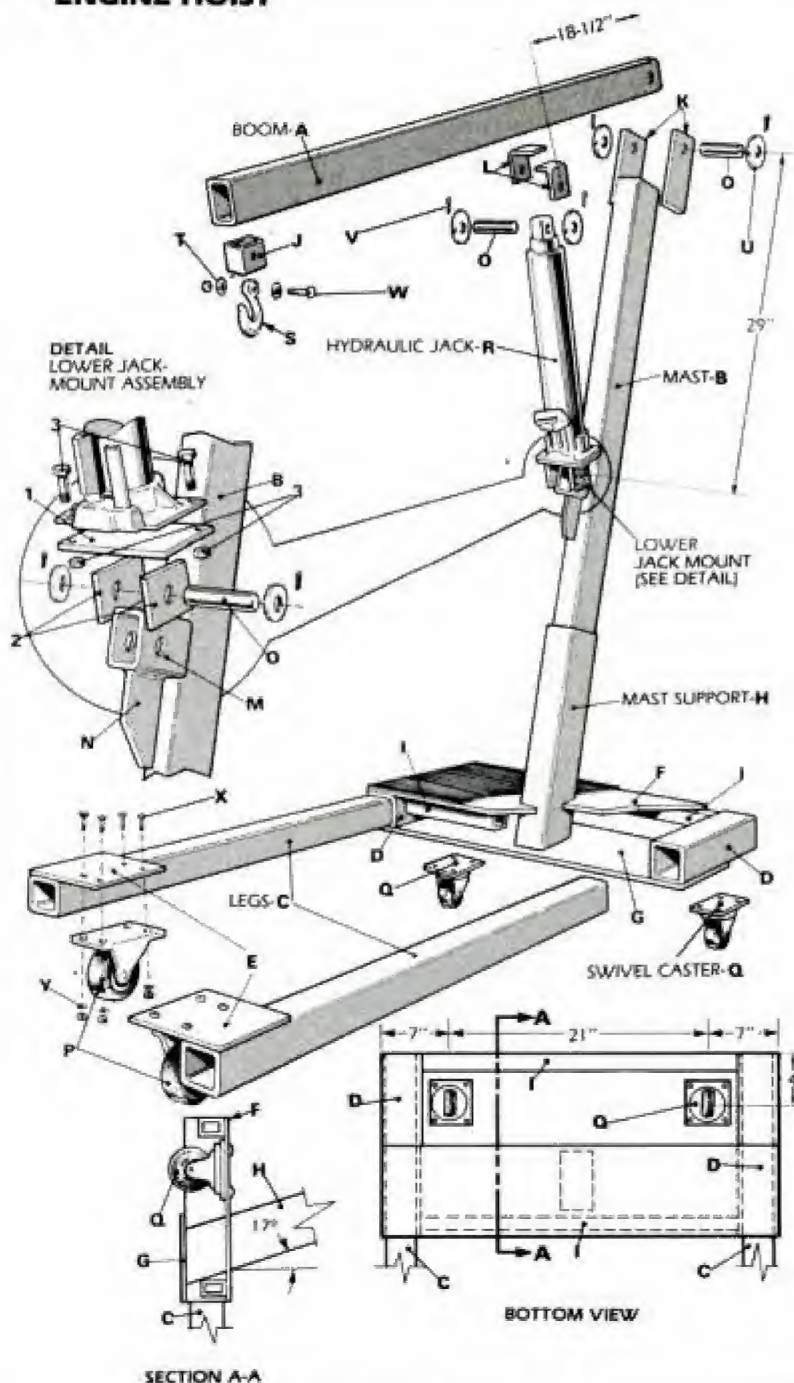
was available at a steel tubing dealer while the plate and angle iron were purchased at an iron works outlet.

We cut pieces to size using an abrasive-wheeled cut-off saw. If you don't have access to one, have all pieces cut to size by the distributor; he'll charge you about \$1 or so per cut.

The rectangular hole in the upper base plate can either be torched out or cut by drilling 3/8-in. holes around the perimeter, then connected by sawing through with a jig saw. Final shaping can be accomplished with a file. The hole should be centered 16 1/4 in. from either end of the upper plate. Once the proper fit of the mast support in its hole

(Please turn to page 172)

ENGINE HOIST



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ENGINE HOIST

(Continued from page 170)

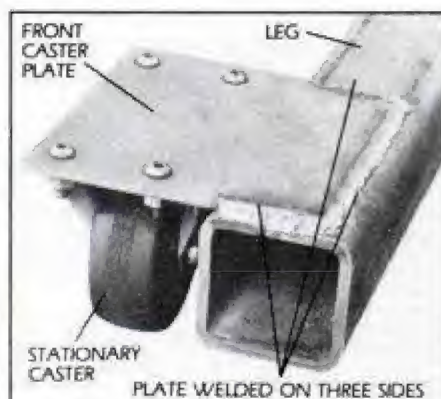
is determined, the upper plate can be turned over and marked for the mounting of the casters.

Our casters were placed with their centers 7 in. from the outside of the plate and 4 in. in from the rear. Since they are the ones which will steer the unit and need to turn, place them so they will not bind against the lateral or leg support. There must be a minimum

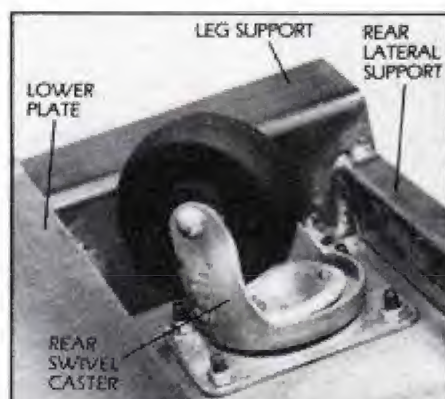
caster height of 6 in.; otherwise the hoist will bottom when negotiating garage or driveway bumps.

Next, using a square, attach the lateral leg supports to the overturned upper plate with clamps and spot-weld them. Stop occasionally to check for squareness. Take into account any cutting errors.

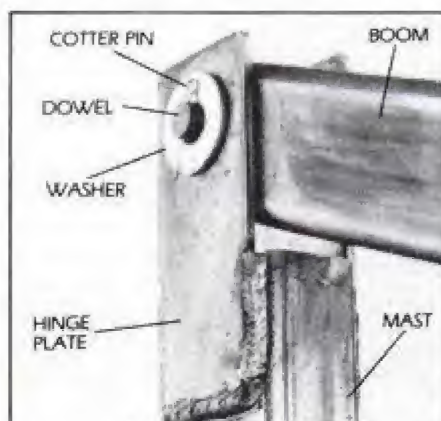
Once the base has been spot-welded together (with the exception of the lower plate), finish the welds by extending them 2½ to 3 in. long. The lower base



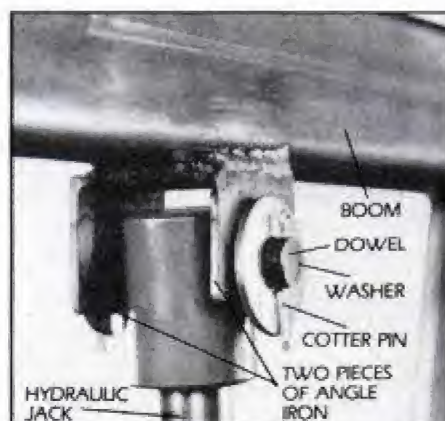
Front casters are stationary and bolted to the plate. The latter is welded to the top of the leg on all three sides.



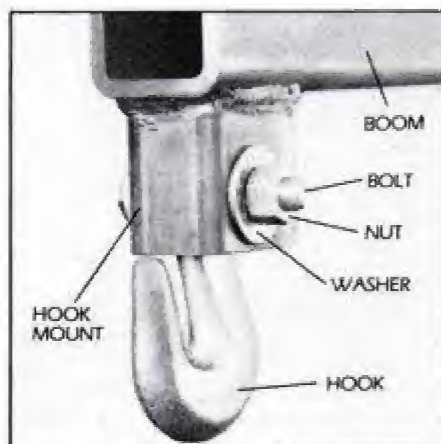
Fix the rear casters with their centers 7 in. from the outside of the plate and 4 in. from the rear. Check for binding.



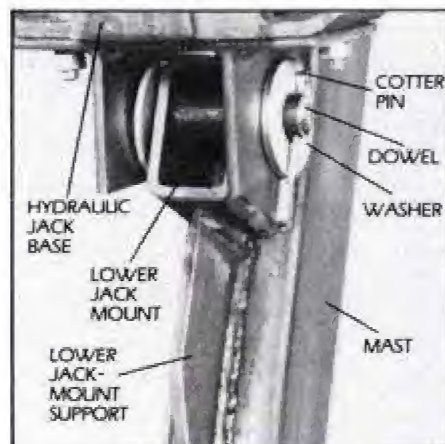
A ¼-in. hole is drilled 1 in. from the top of each hinge plate. Hinge plates must extend at least 4 in. from top of mast.



Upper jack support consists of two pieces of angle iron. After welding them, drill ¼-in. hole and weld assembly to boom.



Drill a ¼-in. hole into the hook mount and hold the hook with a ½-13 bolt. When fastening nut, use locking compound on nut.



Lower jack mount is fixed 29 in. from the top of the mast. The mount support can be any piece of scrap steel plate.

plate should now be welded into place.

The mast support is placed inside its hole and slanted back for a rearward measured angle of 73° from the horizontal plane or 17° from the vertical. Make sure the support is bottomed on to the lower plate and weld the mast support's leading edge to the lower plate. Then, from the top, weld its entire perimeter to the upper plate.

Next, mark the front caster plates to be drilled for the casters. Using the caster as the template, position it as far outside as possible since the caster will be sharing the plate with the hoist leg. Then weld the caster plates on three sides to the top of the leg, and install the casters using 5/16-18 nuts and bolts.

Now move along to the boom hinge plates, lower jack-mounting bracket and upper jack-mounting point. Using a 7/8-in. hole saw, drill a hole 1 in. from the end of the lower mounting bracket through both walls (see jack detail). The boom hinge plates receive a hole 1 3/4 in. from the top and the upper jack-mounting bracket's holes are centered on the bracket. The lower jack bracket is welded 29 in. from the top. The support bracket is welded directly below it. The boom hinge plates are placed on either side, extending 4 in. beyond the top and welded on three sides.

The upper jack-mounting bracket is made up of two angle-iron plates welded together to make a U-bracket. Since this causes one side to be 1/8 in. higher, take it into consideration when drilling 7/8-in. dowel holes. The bracket is first welded together, then welded on to the boom. Its center is 18 1/2 in. from the rear of the boom. The boom receives two more modifications: First, drill a centered 7/8-in. hole 1 1/2 in. from the rear of the boom. Second, prepare the hook mount. It's drilled with a 5/8-in. drill bit through both walls. Then weld it to the end of the boom with a 1/2-13 bolt and nut to hold a hook with an eyelet in place.

After the dowels are drilled 3/32 in. from each end to accept the cotter pins, the mast can be installed into the mast support. The boom is installed into the hinge on the mast and fixed with the dowel flanked by a washer on each side locked in with the cotter pins. Install the jack using the two remaining dowels, again placing a washer and a cotter pin on each end.

Degrease the completed hoist, apply a base coat of Plasti-Kote primer and then add two coats of Plasti-Kote top coat. If you are unable to find Plasti-Kote at a local dealer, contact the firm directly at 1000 Lake Road, Medina, Ohio 44258.

MATERIALS LIST—ENGINE HOIST

Key	No.	Size and description (use)
A	1	2 x 3 x 80" steel tubing (boom)*
B	1	2 x 4 x 84" steel tubing (mast)*
C	2	3 x 3 x 80" steel tubing (legs)*
D	2	3 1/2 x 3 1/2 x 16" steel tubing (leg supports)**
E	2	6 1/2 x 6 1/2" steel plate (front caster plates)**
F	1	16 x 35" steel plate (upper plate)**
G	1	8 x 35" steel plate (lower plate)**
H	1	2 1/2 x 4 1/2 x 21" steel tubing (mast support)**
I	2	1 x 2 x 29" steel tubing (front and rear lateral supports)**
J	1	1 1/2 x 2 x 2 1/2" steel tubing (hook mount)*
K	2	3 x 7" steel plate (boom hinge plates)*
L	2	2 x 2 x 2 3/4" angle iron (upper jack-mounting point)
M	1	1 1/2 x 2 1/2" steel tubing (lower jack-mounting point)*
N	1	2 x 4" steel plate (lower jack-mounting point support)*
O	3	3/4"-dia. x 3 1/4" round steel rod pivot
P	2	6" high stationary casters
Q	2	6" high swivel casters
R	1	24" Blackhawk hydraulic jack
S	1	4 1/2" x 2 1/2" x 3/4", 1/2"-hole-size hook
T	2	1/2" washers
U	6	3/4" washers
V	6	2" cotter pins
W	1	1/2-13 bolt 2 1/2" long, and nut
X	16	5/16 x 3/4 x 18 button Allen-head screws and nuts
Y	16	3/16" lock washers

*1/4" wall thickness

**3/16" wall thickness

Parts 1, 2 and 3 come preassembled with the Blackhawk hydraulic jack unit; thus, they're not listed in our materials list and no assembly instructions are given. The jack is available from Metro Hydraulic Jack Co. of N.J., 52 Elm St., Newark, N.J. 07105—telephone (201) 589-4663. When ordering, use part No. 960-00003-109. It's \$158.50.

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LONG LIVE THE HUMVWV

(Continued from page 91)

will be quickly convertible to three different configurations—weapons carrier, utility vehicle and field ambulance. Within these categories, still more variations are possible. Three ambulance versions will carry from four to eight litter patients and in their smaller modes will be readily transportable by helicopter (as will most of the combat-support configurations).

In its utility role, the Humvee will haul troops, cargo and communications gear, carry out front-line reconnaissance patrols, function as a mobile command post and—like its predecessor—may occasionally serve as a refuge for certain extracurricular GI activities involving the opposite sex.

Deadly firepower

As an attack vehicle, the Humvee will carry a potent mix of weapons ranging from machine guns and grenade launchers to the deadly TOW anti-tank missile. A clever pop-up gun turret and ballistic-resistant armored shell provide crew protection in combat, allowing it to pursue an enemy far more aggressively than the exposed, open-top jeep ever could. It can even mount the Hellfire missile, an advanced, laser-guided antitank weapon, normally air-launched from helicopter gunships, that actually has more range and striking power than the TOW missile system.

The Humvee is so versatile, in fact, that it will eventually replace not only the jeep, but also the ½-ton M274 Mule and the big six-wheel-drive, 1¼-ton M561 Gama Goat, both, like the jeep, well past their prime. The Humvee will thus take over the roles of three tactical vehicles ranging in capacity all the way from ¼ to 1¼ tons. The result will be standardization of parts, reduced maintenance costs, easier battlefield service, and greater operational availability.

Three-way competition

To obtain competitive bids for the Humvee, the Army's Tank-Automotive Command (TACOM) selected three prominent manufacturers of military equipment—AMC's AM General Div., maker of both Army jeeps and American Motors' commercial Jeep; Teledyne Continental Motors; and General Dynamics, which recently acquired Chrysler Corp.'s prestigious Chrysler Defense Div. Each of the three came up with its own version of the Humvee and submitted 11 prototypes to TACOM for testing and evaluation early last year.

To the victor will go a lucrative contract for the production of as many as 50,000 Humvees over the next five years, with a potential of many thou-

sands more well into the next decade. By the time you read this, the winner should be known, or soon will be. AM General, incidentally, has already coined a name for its entry—it's the Hummer, an eminently more appealing moniker than either Humvee or the unpronounceable HMMWV.

Stiff Army requirements

Whichever is chosen, all three entries will be basically similar in many respects in order to meet stiff requirements established by the Army. In addition to the capabilities already noted, the new jeep of the future must accelerate from zero to 30 mph in 6 to 8 seconds, maintain a top speed of 60 mph on the highway and 40 mph off-road, climb a 60-percent (54°) grade, operate on a 40-percent side slope without slipping or tipping, and have a cruising range of 300 miles. It must be

able to climb over obstacles 18 to 22 inches high and ford streams up to 30 inches deep (60 inches deep with an added engine-breather kit).

Automatic transmission

Unlike the jeep, its successor will have a diesel engine and—of all things—an automatic transmission. The latter is not for luxury. The Army's reasoning: Most of today's teen-agers have learned to drive in cars with automatic transmissions. An automatic-shift Humvee will thus be more familiar and easier to handle, while also saving expensive repairs on certain-to-be-abused manual gearshifts and clutches.

While the jeep depended solely on its agility for survival, the Humvee specs call for ballistic protection from 16-grain fragments traveling at 1,400 ft./sec.—enough to stop some small arms

The Legendary Jeep: A Hard Act To Follow

The jeep came into being in 1940, born of a need for a new breed of mechanized packhorse that could carry men and messages to the front lines with speed and agility and not necessarily with the benefit of roads. The motorcycles of WWI, with their quaint little sidecars, had proven woefully inadequate in the mud, sand, snow and shell holes that wars are inevitably fought in. It was time for something better.

As in the current competition for the new Humvee, there were three contenders for the jeep title—Ford, American Bantam and Willys-Overland. The Ford and Bantam entries were judged underpowered and Willys emerged the victor (though Ford was given a contract to share the production and some Bantam vehicles were also used).

Officially, the jeep was a command/reconnaissance car, but in practice it became whatever an enterprising dog-face could make it. It mounted machine guns, chased tanks with bazookas, ferried troops into battle and the wounded back out, and was occasionally pressed into service to forage for beer and friendly *Frauleins*.

Although primitive, even by the standards of its own day, it had a 60-hp, four-cylinder engine, four-wheel drive with synchromesh transmission, high ground clearance and a bone-jarring but virtually unbreakable suspension—a combination that managed to get it most of the places it had to go.

An incredible number of the scrappy little 4×4s—more than 600,000—were produced during World War II. They saw



A jeep under fire in North Africa early in WWII.

action in every theater, from the desert sands of North Africa and the quagmires of Europe to the frozen wastes of Russia and the steamy jungles of Pacific atolls, ultimately jerking and jouncing their way into the hearts of GIs throughout the world.

The origin of the jeep name is still disputed. Some say it came from a comic strip character called Eugene the Jeep, a creature endowed with extraordinary powers. Both Willys and Bantam insisted they coined it, and Willys later commandeered it as a proprietary trade name, spelling it with a capital J. The Army, however, not one to be caught in the crossfire of public controversy, has diplomatically maintained that "jeep" is merely the natural spoken sound for the acronym GP, standing for general-purpose vehicle.

However it got its name, the immortal jeep has been a cherished American legend for more than 40 years. For the fledgling Humvee, it will be a hard act to follow.—S.G.

fire and shrapnel. The Humvee will also have an explosion-proof fuel tank and so-called "run-flat" tires designed to provide emergency support even when ruptured.

Despite their enforced similarity, the competing Humvees do differ in some significant and surprising ways. General Dynamics, for instance, is pinning its hopes on an air-cooled diesel, while the other two use liquid cooling. GD's argument: 30 to 40 percent of all engine-related breakdowns in combat are caused by failures in the complex plumbing of a liquid-cooling system. An air-cooled engine, GD claims, would be free of such problems and would operate in temperature extremes from desert heat to arctic cold without supplementary equipment.

The powerplants

The General Dynamics diesel is a 160-hp, 400-cu.-in. Deutz V8, a German design made in Canada. AM General's Hummer uses a 130-hp, 378-cu.-in. V8 diesel from Chevrolet, while Teledyne has adopted International Harvester's 170-hp, 420-cu.-in. V8 diesel.

All three transmissions are stock three-speed automatics with dual-range transfer cases, with one notable difference: Both AM General and Gen-

eral Dynamics have full-time four-wheel drive, while Teledyne's is selective. The two-wheel-drive option, claims Teledyne, improves gas mileage and reduces drive-train wear on good road surfaces where 4wd is not needed. All three manufacturers offer power steering and braking.

The high/low problem

While high ground clearance and a low silhouette are both major needs in an off-road combat vehicle, the two obviously work against each other: How do you design a vehicle that's both high and low at the same time? AM General attacks the problem in a novel way. The wheels on its Hummer are driven at the rim rather than the hub. A ring gear around the rim engages a pinion gear on the axle at the top of the wheel. This means that the axle is 4 inches above the wheel hub, which provides both high ground clearance—a full 16 inches—and low overall height. The Hummer also has independent coil-spring suspension all around.

Both General Dynamics and Teledyne favor a more conventional layout, contending that the reliability of a proven drive arrangement outweighs the advantages gained through the use of an unorthodox approach. General Dynamics has independent coil-spring

suspension in front, but a solid rear axle, maintaining that high ground clearance between axles is more important than clearance between opposing wheels.

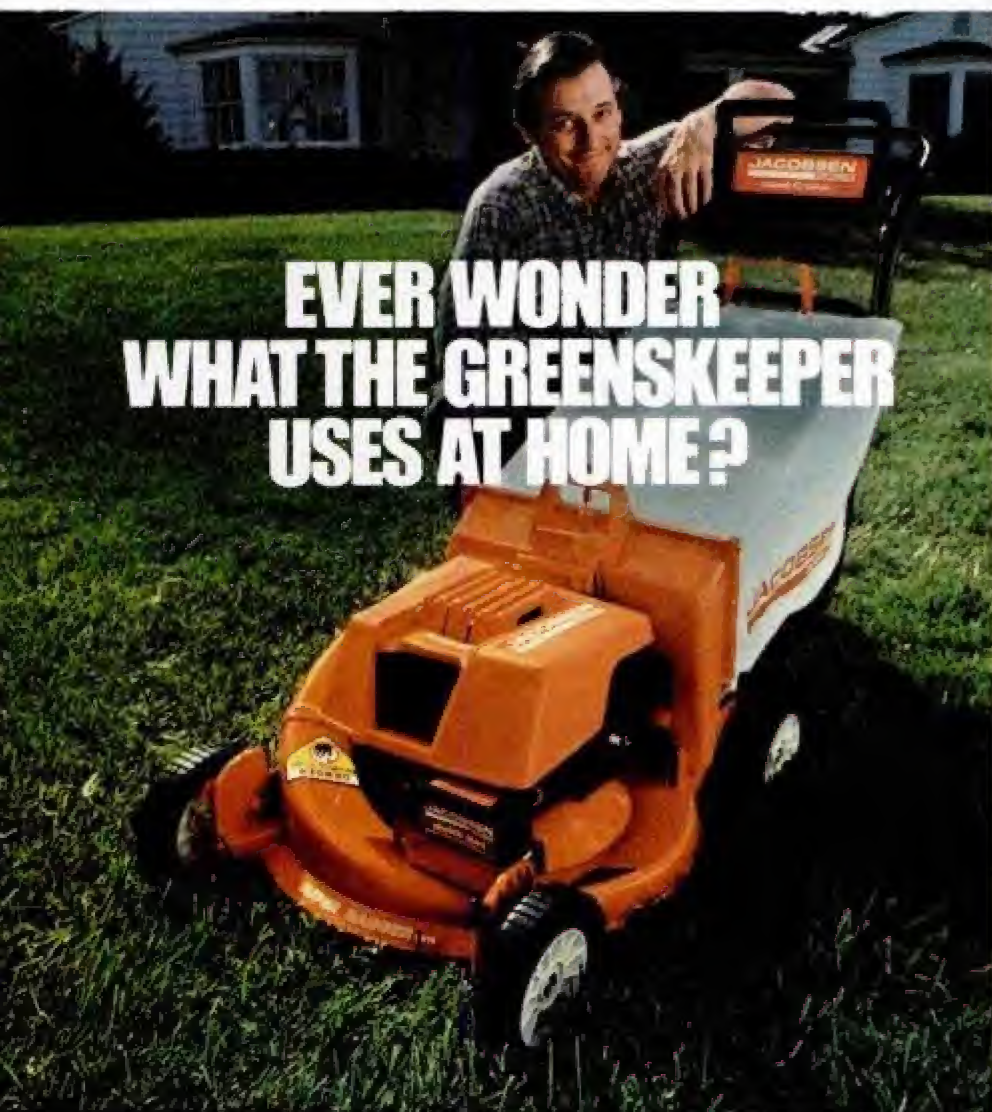
Teledyne has independent suspension on all four wheels, controlled by a unique variable-rate torsion-bar system that's designed to provide a soft ride under light loads and a stiffer, more stable ride under heavy loads. Although the manufacturers arrive at it in different ways, all three contenders meet the Army's maximum height allowance of 69 inches, which is 2 inches less than the classic jeep's profile.

More for the money

Whoever builds it, the new Humvee will cost an estimated \$27,000 per copy—not an exorbitant price when you consider all the things it can do compared to its far more primitive predecessor. (Just to replicate the current jeep as it stands would cost a hefty \$15,000 per copy.)

While the Humvee may never have an opportunity to match the fame and glory of the immortal World War II jeep, if the vehicle is half as durable and half as well-loved, it could turn out to be a bargain at almost any price.

PM



If he wants to give his lawn the same professional touch he gives his golf course, he probably uses a Jacobsen® Super Bagger™ power mower.

The Super Bagger's high-vacuum action stands up uncut grass for a close, even cut that's adjustable to within fractions of an inch. The new professional-style Command Control™ System puts all the operating controls on the handle for convenient fingertip access. The super-large 3-bushel rear catcher is zipperless for quick, easy emptying. And, like all Jacobsen walk-behind mowers, it complies with latest CPSC safety standards.

The Jacobsen Super Bagger. The power mower for perfectionists who want to mow like a pro.

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Homelite Division of Textron Inc.

Материал: лицензионный авторский рисунок

DRIVING FORDS

(Continued from page 97)

add a central console with additional storage. A larger optional console adds a covered bin and a graphic warning module—or the gauges (unfortunately, you can't have both).

The base bucket seats, which are otherwise fairly nice in both shape and appearance, don't recline; the optional highline seats are excellent, and they do.

Exclusive to the Tempo/Topaz is a new 2.3-liter, pushrod, four-cylinder engine—a distant relative of Ford's 3.3-liter Six (same bore centers), but no relation to the overhead-cam 2.3 that's been around for years. It's short and compact for transverse mounting and about as conventional as a carpenter's claw hammer below the head gasket. The block and head are iron, but the intake manifold, water pump and front



Ford's Bronco II will go against Chevy's mini-Blazer. It'll be available in 4x4.

cover are aluminum. The most innovative uses of lightweight material, however, are a die-cast aluminum oilpan and an aluminum radiator with plastic end caps.

What engine trickery exists is primarily in cylinder-head and combustion-chamber design, plus state-of-the-art electronic control. Using techniques adapted from their PROCO (Programmed Combustion) research work of a few years back, Ford's engine engineers have come up with special intake valve shrouds to impart swirl to the fuel/air charge as it enters the chamber. This swirling motion (around a centrally located sparkplug) continues through the compression and ignition stages, creating a highly efficient fast-burn condition without detonation at the relatively high compression ratio of 9.0 to 1. The bottom line is impressive economy with respectable performance, the latter coming more from a hefty 125 ft.-lb. of torque at 2,700 rpm than from the engine's mediocre 90 hp at 4,700.

With their standard four-speed manual "FS" (Fuel Saver) transaxle, the Tempo and Topaz are EPA rated at an estimated 28 mpg city and 43 highway. The optional close-ratio five-speed delivers 26/41 mpg EPA economy, and the available three-speed automatic gives 25/35 (preliminary estimates). The five-speed, incidentally—built by

Toyo Kogyo of Japan to a Ford design—has excellent shift feel and quality. It does need a stronger detent or a lift ring to avoid your getting into the reverse slot by mistake when looking for first or downshifting to second in a hurry.

Control of the engine, sensing of its operating parameters and built-in service diagnostics are all handled by Ford's most powerful car computer yet, EEC IV. This fourth-generation electronic engine control does everything from sniff oxygen content in the exhaust (to maintain the proper fuel-air mixture at the electronically controlled two-barrel carburetor) to adjust idle speed according to accessory load and compensate for friction changes and wear as the engine ages. It also stores any malfunction in the memory for later diagnosis by a technician.

Front suspension is a fairly standard MacPherson strut arrangement with the spring axis offset from the strut shocks for reduced friction. A stabilizer bar is standard; the "scrub" radius is negative for braking and steering stability on uneven-traction surfaces, and a combination of unequal-length steering arms, increased left-wheel camber and a special torque tube in the right-side driveshaft eliminates most of the usual fwd torque steer.

Rear suspension is fully independent, also with MacPherson struts, with each strut located by two parallel transverse arms and a fore-aft tie rod. This system is new for Ford in this country, and it works exceedingly well, minimizing geometry changes for excellent handling while sponging up road shocks and bumps through specially designed bushings.

The dual-circuit brake system is split diagonally—one (low-drag) front disc and the opposite rear drum will operate

if one circuit fails—and the quick-fill master cylinder gives fast response. Steering is rack-and-pinion, with optional power assist. The parking brake lever is tunnel-mounted and uses a low-friction, self-cleaning cable. Tires are all-season, low-rolling-resistance, steel-belted radials individually indexed to their wheels for optimum balance.

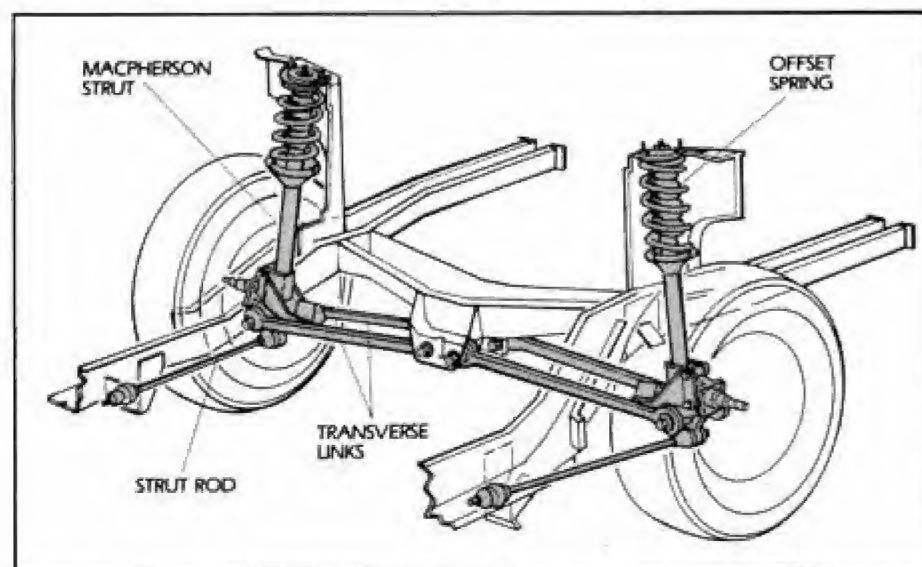
The unitized body is rust-protected, and even the car's door hinges and weather stripping are specially designed for a "luxury-car quality door-closing sound." Among the more interesting options are an antitheft alarm system, remote-control rear quarter windows, power-adjusted outside mirrors, a Class I (light-duty) towing package and a "TR" handling package with Michelin TRX tires on cast-aluminum wheels.

In other words, Ford's Tempo/Topaz designers, engineers and planners have done their homework well. Unlike the smaller Escort/Lynx series, which have matured and improved tremendously since their somewhat disappointing '81 introduction (and with which they share only a few components and some interior sheet metal), the Tempo and Topaz seem correct and complete right out of the box.

While the Tempo/Topaz twins aren't as technically sophisticated as their distant relative, the Sierra (see *Firsthand Report: Driving The European Ford Sierra*, page 81), they're more than competent enough to deal with the American market competition. They deliver respectable performance with excellent economy, room and comfort for their size. With all that, plus handsome looks and prices expected to start well below \$7,000, they can't lose.

T-Bird Turbo Coupe

While the '84 Tempo and Topaz are handsome but practical, Ford's new



The rear suspension for the Tempo/Topaz is located laterally by parallel transverse links and longitudinally by strut rods. This kind of a setup is called Quadralink.

Thunderbird Turbo Coupe is pure driving excitement.

First, the Turbo Coupe is motivated very smartly (about nine seconds 0-60) by a 145-hp, turbocharged, fuel-injected, 2.3-liter Four bolted to the same close-ratio Borg Warner five-speed that sits behind the Mustang/Capri 5.0-liter HO V8.

Second, the car is supported by a specially tuned performance version of the T-Bird/Cougar gas-shock suspension, complete with a 15 to 1 fast-ratio power steering gear, standard rear sway bar, Traction-Lok differential and twin horizontal dampers to control rear axle movement during acceleration, braking, cornering and transitional maneuvers.

On the outside, it's identified by blacked-out headlamp bezels, twin recessed fog lamps, P205/70HR14 Good-year Eagle blackwall tires on special "Swiss cheese" aluminum wheels and wide, black side moldings that mate with matching bumper rub strips to completely encircle the body. Inside are contoured, articulated bucket seats with five different manual adjustments including a Toyota-like inflatable lumbar support. Dual electric remote-control mirrors, a leather-wrapped sport steering wheel and a digital electronic clock are standard.

Only the Thunderbird's pedestrian instrument panel will disappoint the serious driver at which this automobile is aimed: it's brush-finished black (not wood grain, thankfully) in the Turbo Coupe but has no provision for gauges.

There is a tachometer, but everything else a driver would like to know about the sophisticated engine's sta-



The top-of-the-line XLS Bronco II comes with huge tires and some flashy visuals.

tus—including turbo boost—is handled by idiot lights.

That one complaint aside, driving the Turbo Coupe is a revelation. Forget everything you ever heard about the noisy, shaky, limp-wristed Turbo 2.3 that found its way into a handful of Mustangs and Capris a few years ago. This one uses the same basic overhead-cam Four as a starting point, but the similarity ends there. It's a blow-

through system, boosted before the throttle to minimize lag, with multiport injection and EEC IV sensing and control, and it flat flies!

Because it's considerably lighter than a V8, the turbo engine puts less weight on the front wheels, reducing understeer and making the Turbo Coupe the best-handling Ford product we've driven in many, many years. For those who care, the Turbo Coupe is EPA rated at an estimated 21 mpg city, 33 highway and the car seems a performance bargain at \$11,790. And the Turbo Coupe's very impressive high-tech engine will also be available in Turbo Mustangs and Capris.

Bronco II

Equally impressive in its own way is the new Ranger-based Bronco II, which features optional automatic-locking 4wd hubs, standard V6 power (with EEC IV) and a choice of five-speed manual or three-speed automatic transmission.

The Bronco II is broad-shouldered, hairy-chested handsome, rides and handles surprisingly well and slogs through mud and snow like a pro. In other words, it's fully competitive with Chevy's S-10 Blazer and GMC's S-15 Jimmy—as the compact truck wars get hotter still. **PM**

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fingertip deck height
adjustment.

Optional rear catcher
—supports standard
trash can.

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PACE COMMAND
drive control—
for simple "no hands"
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It's amazing how many riding mowers are little more than lawn mowers with seats.

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Compare the RMX with other riding mowers on the market. In fact, test drive it! You'll see why it's earned its reputation as the most machine for the money.

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DRIVING MERCEDES, BMW

(Continued from page 105)

of this car. The European engine has been very responsive to the throttle in all your tests, revving smoothly to the redline and feeling like it's producing more than its 90 rated hp in fuel-injected trim. Even the carbureted version has performed well. You've already pushed a 190E to a top speed of 200 km/h (124 mph) on a closed-off stretch of test road and the engine felt ready to do it again and again. It was



Interior of 190 is characteristically M-B and is roomy despite interior downsizing.

just as at home cruising at 55 mph.

There's no question that buyers will like the handling and road feel. Daimler-Benz engineers examined 70 different rear-suspension systems before they decided to design their own. This new system gives the 190 ride and handling as good as or better than any other Mercedes. And that's saying something. The suspension has five links to control wheel movement, along with coil springs, gas-pressurized tubular shock absorbers and an antiroll stabilizer bar. Unlike other independent rear suspensions, this five-link setup will not toe in or out when loadings change abruptly, which is what causes the phenomenon known as trailing-throttle oversteer. In layman's terms, it means the rear spins around on you if you suddenly lift off the gas in a turn.

Safe and unflappable

You've already tried to flap the 190 on all kinds of country roads—flat, bumpy, turns with bumps, hills, potholed and chucked dirt paths. It has remained unflappable. In fact, because of its inherent stability, this could be one of the safest cars ever built. You can do really stupid things in this car and not hurt yourself. The car's handling is so good that you don't have to be a good driver to look like one. Of course, if you are a good driver, you can use this car to its limits—and yours—

and really have a good time. In the event that you go too far and exceed the car's—or your—limits, it's nice to know that the 190 is one of the most crashworthy cars ever built. The structure of the car is designed from the ground up to deform in a controlled way, thereby managing the kinetic energy of a crash in a manner least harmful to passengers.

In addition to the handling capability built into the suspension, Daimler-Benz engineers also dialed in antidive and antisquat geometry. Combined with a fairly conventional modified MacPherson strut front suspension (with the spring mounted on the control arm), the 190 gives its passengers an incredibly smooth, big-Mercedes ride.

Backing up the engine is a plethora of transmission selections—a four-speed stick, five-speed stick and a really trick two-mode, four-speed automatic. In the S-mode, the transmission allows you to make full use of power reserves and shifts through all four gears in a conventional manner. In the E-mode, the transmission starts in second rather than first on rollaway, and the upshifts are made at lower speeds. This gives more economical operation and is really handy on slippery roads. Out of character, though, is the fact that of the four stick shift cars you've driven, all four have had loose, sloppy shift linkages.

Steering is conventional Mercedes-Benz, meaning manual recirculating ball with power assist optional. It's curious that a leading-edge technology company like Daimler-Benz should still use a steering system considered archaic in many circles. Yet, their engineers claim it's simply better than a rack-and-pinion system.



New suspension design has cured BMW of most of its trailing-throttle oversteer. Spoiler is only on European models.

Standard tire is a 175/70R14 on a 5×14 wheel. Brakes are power-assisted discs at all four corners. In Europe, the excellent antiskid ABS brake system is optional. Too bad they don't offer it on U.S. versions. Still, the standard four-wheel disc system is as good as you'll find.

You wonder why Daimler-Benz engineers didn't go to front-wheel drive on their small sedan. The engineers have told you the previous evening that there were several reasons. When the steer-

ing and driving wheels are separate, it's easier to tune suspension components. And ride and handling were among the prime considerations in the development of this car. It's also easier to fit different engines into a rear-wheel-drive package, and this car will be fitted with several different engines in different parts of the world. Additionally, they've told you, simply put, that in this size and weight of car, rear drive is superior. And who will argue with a Daimler-Benz engineer?

Significant differences

Yes, this new Mercedes-Benz is different. And the biggest difference of all is that it's small. Not cheap. Just small. The executives you've met with here in Spain have made it very clear that they had no intention of building a cheap Mercedes, just a smaller one. So forget all the rumors about a \$10,000 Mercedes. It just ain't gonna happen.

What has happened is that the engineers at Daimler-Benz recognized that the forces of conservatism had to affect even the mighty three-pointed star and its customers. And so they took their customary seven years and developed a fine, small automobile. At a price.

Externally, the car bears a strong resemblance to the newer S-class Mercedes sedans. The same attention to aerodynamic detail is evident wherever you look, from the laid-back windshield to the partial bellypans covering the underside of the chassis, to the clipped-in rear end. In fact, the 190 sports one of the lowest coefficients of drag ever recorded for a production sedan—0.33. Clean aerodynamics helps fuel economy which, naturally, was a consideration in building this car.

Dimensionally, the W201 (its engineering designation) sits on a 105-in. wheelbase and is just over 174-in. long. Curb weight is 2,375 pounds. That's 12 in. shorter and about 600 pounds lighter than the 300D and 22.6 in. shorter and a whopping 1,000 pounds lighter than the large S-class sedans. Yet, the car is a full four-door model (only) and the front seats are virtually the same size as those on larger Mercedes-Benz models. Interior seating comfort is excellent for four, tight in the back for five.

Fuel mileage

But you don't buy a car like this for hauling passengers and freight, so you don't expect room for eight. What you do expect is high fuel mileage. The engineers have told you that, in tests, the European version of the car has scored between 24 and 27 mpg on the highway. On the European urban mpg cycle, the 190 racked up 22.8 mpg.

Like other Mercedes-Benz models, the company expects to sell all the 190s

(220s) they export to the United States. And like other Mercedes-Benz models, most of these outrageously priced \$24,000 compacts will be sold to people who don't know a thing about the car's engineering, about its handling, its stability, its acceleration, or its braking prowess. And they couldn't care less. All they know is that they're driving a Mercedes that costs \$24,000.

And right now, you don't care either. You've got a 100-mile drive ahead of you from Cadiz on the coast up to Jerez. The road is flat and smooth and traffic-free. You'll be there in an hour.

Wonder what the poor people are doing today?—Joe Oldham

BMW 318i

Success is tough to handle. Take BMW, for example. Sixteen years ago, they invented the sports sedan—a boxy, inexpensive two-door that could handily outperform any small sports car, but carry four passengers and their luggage all the while. This 2002 established a whole new market segment, of which BMW was the acknowledged standard of excellence.

The 2002 was followed in turn by the 320i, which was more of the same in a rounder, softer package. The 320i nev-

er became a cult car like the 2002, but it did capture an even larger market share among the upwardly mobile doctor/lawyer/accountant types who had outgrown their Cutlass Supremes, but weren't quite ready for a Mercedes. BMW sales soared even as other car companies headed for bankruptcy.

This wonderful success is now BMW's biggest liability. To be blunt, the company is scared to tamper with the formula which has been so good to them for so long. Which brings us to the third generation of BMW's small sports sedan, the 1983 318i. Unless you're a BMW zealot with foam-flecked lips, you'll scarcely be able to tell the new car and the old one apart.

Which, of course, is deliberate on the part of BMW director Dr. Ing. Rademacher. In his view, BMW is much better off to keep building conservative, rear-wheel-drive sedans, rather than break new ground with a sleekly aerodynamic body, advanced front-wheel drive or state-of-the-art electronics. There are no fads at BMW.

No alienation

That isn't to say there aren't improvements. There are no carryover parts on the new 318i except the basic engine/transmission. Even though the body looks nearly identical to the old

320i, every panel is new. Slightly more rounded contours have reduced aerodynamic drag to 0.38 Cd, which is not particularly low for an all-new sedan, circa 1983. Still, the new body easily accomplishes what must have been Dr. Rademacher's main purpose—not to alienate the traditional BMW buyer.

Hidden under this blunt box are new front and rear suspensions. The front MacPherson struts look pretty conventional, but they're designed to induce a slight amount of understeer in hard cornering. This allows an independent rear suspension with considerably less camber change than the old one. And that means, for the first time ever, the little BMW doesn't try to lift the inside rear wheel in the midst of a corner. Hallelujah!

Hidden differences

Even a loyal BMW enthusiast will have a hard time spotting the interior differences on the new car. There are nearly 2 inches more rear legroom, a little more headroom and elbowroom, but rear passenger space is still limited. The front passengers, however, will be a happy pair. The all-new dash looks just like the old one, which is to say there aren't as many gauges as an enthusiast might desire. But otherwise,

(Please turn to page 180)

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MARINE SURPLUS DEPOT BCRB—8

OPTICS DIVISION

Box 9300, Port Washington, NY 11050

DRIVING MERCEDES, BMW

(Continued from page 179)

the front seat of a BMW 318i is a surprisingly comfortable place to be.

About this "318i" business. In Germany, BMW sells the 3-series with a wide choice of engines, from a 1.6-liter Four to a 2.3-liter Six, and the model name reflects the displacement—316, 318, 320, 323. Americans have always received the 1.8-liter Four, even though the car was called 320.

All this is about to change. This year, we'll get the same fuel-injected, 1.8-liter Four we've always had, now properly called the 318i. But next year, Americans will be the beneficiaries of a new 2.6-liter Six, which will add about 30 hp and bags of torque to the 2,400-pound BMW.

Worth the wait

Is the Six worth waiting for? Well, it cuts 0-to-60 times from 12 seconds to 10.5, increases top speed from 99 mph to 120, preserves the 28-mpg EPA rating and makes the car a lot more pleasant to drive. The Six is uncannily smooth, like all BMW Sixes. The Four is buzzy and busy, like most under-two-liter Fours. Yes, you might say the Six is worth waiting for.

You might also want to wait for the four-door. Indeed. After 16 years of clambering over the front seats, BMW-kinder will have their own set of doors starting in 1984. The four-door is literally built from the two-door pan, so there's no increase in legroom, but there is a giant step forward in convenience. Dr. Rademacher expects the new four-door to capture between 60 and 80 percent of all 3-series sales, worldwide.

Of course, the Six and the four-door will cost more. In fact, the 318i will cost more than the 320i it replaces. Base price on the four-cylinder, two-door in the United States will be around \$14,000. Add the normal BMW options, and you'll be hard-pressed to buy a 318i for less than \$17,000. Add in another hefty premium for two more cylinders and two more doors, and you'll surely be ogling the first \$20,000 BMW 3-series.

The bottom line is that the little BMW sports sedan has finally grown up, gone all smooth and refined and expensive on us. And BMW, for all its conservative my-goodness-don't-change-anything approach to styling and engineering, has lost sight of just what it was that made the 2002 such a success—an affordable price tag, the aesthetics of a brick and astounding performance. Luckily, you can still buy a modern-day BMW 2002. It's called a Volkswagen GTI, and it costs just \$7,995.—*Rich Taylor*

OWNERS REPORT: CAMARO

(Continued from page 107)

surface, so it leaked when I got the car."

An Alabama poultry raiser fumed, "I've already had three automatic transmissions installed, replaced the starter once, the T-top leaks, and the throttle-body injectors still need to be

adjusted. I've met other owners who've had similar problems or worse. Two have traded off their cars. Chevrolet did their homework on styling and handling, but I fear they've ignored some other important areas."

In the odd-but-true category, one owner mentioned that rain water, leaking into the induction system through the cold-air hood scoops, ended up

causing a connecting rod to break when he tried to start his car. His engine was exchanged under warranty.

Nearly half of all the Camaro buyers we queried had chosen the 305-cu.-in. V8—the same engine that Chevrolet supplies for the Trans Am. And as in our Trans Am Owners Report, a nagging complaint from Camaro owners

(Please turn to page 182)

SUMMARY OF 1982-83 CHEVROLET CAMARO OWNERS REPORTS*

Total miles driven 1,317,594	Specific likes:	Workmanship opinion:	Dealer service opinion:
Average miles per gallon:	Styling 78.8%	Excellent 26.4%	Excellent 18.0%
Ohv 2.5-liter Four	Handling 56.8%	Good 47.6%	Good 36.5%
In town 23.5	Comfort 23.4	Average 16.9	Average 25.6
On the highway 28.5	Performance 22.1	Poor 9.1	Poor 19.9
Ohv 3.8-liter V6	Economy 15.8	Comfort opinion (front seats):	Number of vehicles owned:
In town 19.6	Specific dislikes:	Excellent 59.7%	This car only 39.2%
On the highway 24.9	No complaints 18.4%	Good 30.3	Two cars 41.9
Ohv 5-liter V8	Disappointing fuel	Average 8.2	Three cars 13.7
In town 14.8	mileage 12.4	Poor 1.7	Four or more cars 5.3
On the highway 18.8	Quality of materials 10.6	Comfort opinion (rear seats):	Makes of other cars owned:
Engine choices:	Workmanship 7.8	Excellent 7.3%	Chevrolet 34.8%
Ohv 2.5-liter Four 11.5%	Rattles and noises 6.5	Good 33.9	Ford 15.2
Ohv 3.8-liter V6 38.8	What changes would you like?	Average 33.0	Oldsmobile 12.3
Ohv 5-liter V8 49.8	Five-speed transmission 13.2%	Poor 25.7	Cadillac 8.0
Transmission choices:	Better materials 11.8	Had any mechanical trouble?	Datsun 7.2
Automatic three-speed 75.1%	No changes 11.3	Yes 61.4%	Pontiac 7.2
Manual four-speed 24.9	Better fuel mileage 6.6	No 38.6	Age distribution of owners:
Why did you choose this car?	Seat shape/style 5.7	What type of trouble?	15-29 years 55.1%
Styling 88.0%	How much did you pay?	Transmission 25.7%	30-49 years 35.9
Handling 16.9	Average \$11,383	Electrical 8.6	50-plus 8.0
Performance 11.6	Range \$7,000-	Oil leaks 7.1	Would you buy another Chevrolet
Past experience 9.3	16,000	Clutch 7.1	product?
Economy 7.1		Air conditioner 5.7	Yes 84.0%
		Shifter 5.7	No 16.0
		Dealer repairs satisfactory?	Would you buy another Camaro?
		Yes 57.1%	Yes 75.0%
		No 42.9	No 25.0

*Percentages might not equal 100% due to rounding or insufficient data.

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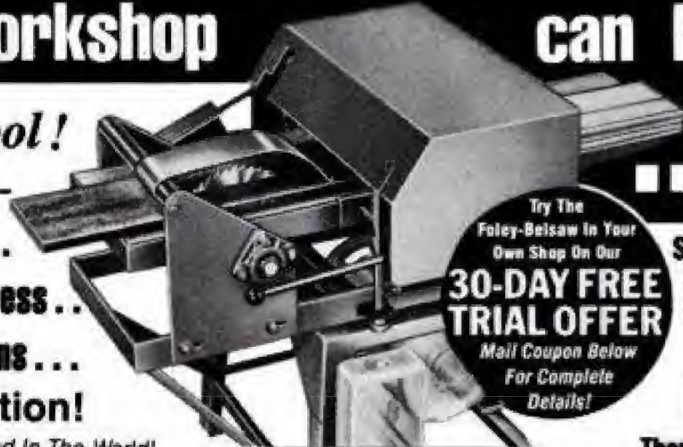
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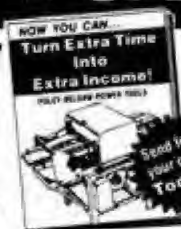
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Robert Sawyer — Roseburg, Oregon

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OWNERS REPORT: CAMARO

(Continued from page 181)

was lower-than-expected fuel mileage. According to our survey, this five-liter V8 delivers 14.8 mpg in town and 18.8 on the highway. Compare that with the EPA's 17/23 mpg city/highway and you'll understand the disappointment.

There was a little disappointment, too, with the V8's performance. This was by no means universal, because plenty of people praised this engine's peppiness. But a few—as always—want more power. However, it's important to balance out the never-ending lament for lost horses with a growing satisfaction. This satisfaction was expressed by a Texas architect:

"As a general statement, the Z-28 is a good step toward cars of the future. I sincerely hope Chevrolet doesn't go backward into a larger-displacement engine to get more performance at the cost of fuel economy. Instead of the 350 V8 they've been talking about, I'd like to see them offer a high-output V6, perhaps with a turbocharger. High performance requires efficiency, and efficiency delivers more mpg."

Only 25 percent of our respondents had opted for the manual four-speed gearbox, and an amazing 13.2 percent told us they would like—and presumably would have bought—a five-speed if it had been available. Unfortunately, at the time we conducted our survey, the 1983 Camaros had just come out. The 1983 models offer five-speeds (the Warner T-5) with all three engines.

Front-seat comfort came in for rave reviews, with no less than 90 percent rating that area good to excellent; quite a high score. An unemployed Tennessee said, "Comfort in the Z-28's Contour seats is great, and the Extended Range stereo is even greater. Everyone compliments the stereo system."

However, the rear seat received considerably less praise, especially from a California dispatcher who has an amusing way of referring to children: "The rear seats are for rug rats only."

On the whole, praises outweighed complaints by a wide margin. These comments pretty well sum up what Camaro owners think of their cars:

"The 1982 Camaros are the sharpest Chevrolet has offered. I'm proud to own one."—New York student.

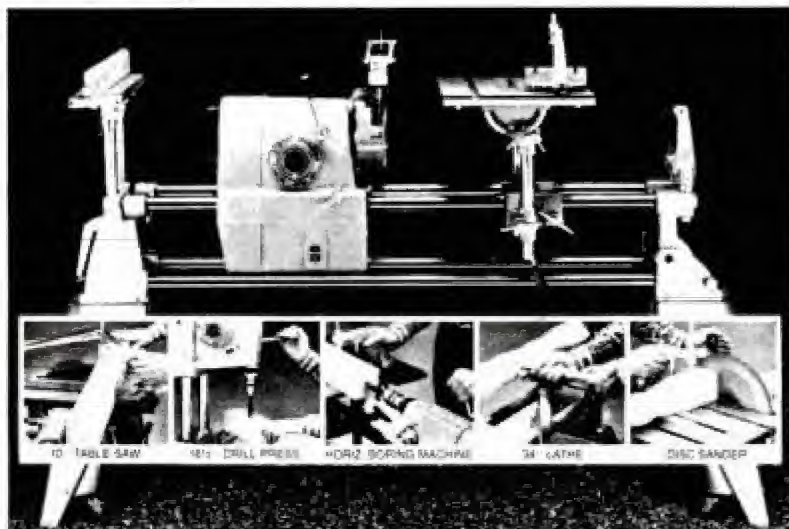
"It's a great head-turning looker, with fantastic handling and good inside comfort. Also, it's fun to drive."—Kentucky store clerk.

And finally, from a California manager, "Show me another \$12,500 car that'll pull .836g on the skidpad, that looks this good, with clean, smooth styling, fast-enough performance, great ergonomics, and a good stereo. I think I got a deal!"

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United Metal Services, Inc.

BUILD OUR TOOLBOX

(Continued from page 111)

corners, then restrain where necessary. After rounding all the edges, install the eight brass corner caps.

The eight right-angle corner braces are made from 18-gauge (.040-in. thick) sheet brass. Cut out the rough shape of the corner angles with metal shears or a sabre saw with a metal cutting blade. Then finish-shape each piece on a grinder or a rotary file mounted in a drill press. Wear safety glasses throughout this procedure.



Install hinges with the lid clamped in position. Pipe clamps with wood blocks ensure proper alignment.



Corners conceal the screws which are used to hold the top compartment together.

Next, bend each corner angle around a $\frac{3}{8}$ -in.-dia. rod to conform to the rounded box edges. Bore two $\frac{1}{8}$ -in.-dia. mounting holes in each piece and countersink for $\frac{3}{8}$ -in. No. 5 fh screws.

To help strengthen the luggage-style carrying handle, steel reinforcement plates are mounted inside the lid.

A felt liner is glued to the toolbox interior for both appearance and tool protection. Use wood glue or contact cement on hardboard or wood surfaces. Adhere the felt to metal surfaces with an appropriate glue, such as Goodyear Pliobond cement.

A magnetic catch prevents the front panel from falling open whenever the lid is raised. Make the catch by gluing a 2-in. length of flexible magnetic strip to the partition end. Mount a steel strike plate (an electrical outlet box knock-out disc) to the front panel directly op-

(Please turn to page 184)



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BUILD OUR TOOLBOX

(Continued from page 183)

posite the magnet. Attach a small felt-covered wood block to the partition above the magnet. This will serve to act as a stop against which the panel can close.

Finishing the toolbox

Complete the toolbox with a coat of Pratt and Lambert satin varnish (No. R-11) thinned 50 percent with turpentine. Let it dry overnight, then sand

lightly with 220-grit abrasive paper. Remove the sanding dust with a brush, then wipe with a tack cloth. Finally, brush on a second coat of *unthinned* varnish for the final coat. **FM**

MATERIALS LIST—MASTER CRAFTSMAN'S TOOLBOX

Key	No.	Size and description (use)	P	1	1/4 x 7 1/2 x 8 3/4" hardboard (bottom)	X	1	5" luggage-type handle
A	2	1/2 x 8 3/4 x 10 3/4" cherry (box end)			DRAWER C (1 Req'd.)	Y	2	1/4"-dia. x 2 1/2" rod, brass or steel (pin)
B	1	1/2 x 2 1/4 x 19 1/4" cherry (box front)	M	1	1/2 x 1 1/4 x 19 1/4" cherry (front)			
C	1	1/2 x 10 3/4 x 20 1/4" cherry (box back)	N	2	1/2 x 1 1/4 x 7 3/4" pine (side)	Z	2	1/4"-o.d. x 1" spring
D	1	1/2 x 8 3/4 x 20 1/4" cherry (box bottom)	O	1	1/2 x 1 x 18 1/2" pine (back)	AA	2	1/4 x 3/8 x 1/2" brass (strike plate)
E	1	1/2 x 9 1/4 x 20 1/4" cherry (lid top)	P	1	1/4 x 7 1/2 x 18 1/2" hardboard (bottom)	BB	2	1/4"-o.d. x 1/2" copper (liner)
F	2	1/2 x 1 3/4 x 9 1/4" cherry (lid end)			DRAWER D (1 Req'd.)	CC	1	1/2 x 2" flexible magnetic strip
G	2	1/2 x 1 3/4 x 20 1/4" cherry (lid front/back)	M	1	1/2 x 2 1/4 x 19 1/4" cherry (front)	DD	1	1/4 x 3/4"-dia. steel (strike plate)
H	1	1/2 x 8 3/4 x 19 3/4" A/C plywood (compartment bottom)	N	2	1/2 x 2 1/4 x 7 3/4" pine (side)	EE	1	Spacer, size as needed
I1	1	3/4 x 3 3/4 x 7 3/4" pine (partition)	O	1	1/2 x 2 x 18 1/2" pine (back)	FF	1	3/16 x 3/4" x depth to suit, pine (stop)
I2	1	1/2 x 3/4 x 3 3/4" cherry (edging)	P	1	1/4 x 7 1/2 x 18 1/2" hardboard (bottom)	GG	1	3/16 x 3/4" felt (pad)
J	2	1/2 x 1 1/2 x 19 1/4" cherry (front panel rails)			DRAWER E (3 Req'd.)	HH	2	1/4 x 3 1/2"-dia. steel (reinforcing plates)
K	2	1/2 x 1 1/2 x 6 3/4" cherry (front panel stiles)	M	3	1/2 x 1 3/4 x 9 1/4" cherry (front)	II	1	7" chain
L	1	1/4 x 5 1/4 x 16 1/4" cherry plywood (front panel insert)	N	6	1/2 x 1 3/4 x 7 3/4" pine (side)	JJ	11	1 1/2" No. 6 fl. screws
		DRAWER A (1 Req'd.)	O	3	1/2 x 1 3/4 x 8 1/2" pine (back)			Misc.: Hide glue, felt, 3/4" brads, 80- and 220-grit sandpaper.
M	1	1/2 x 1 1/2 x 9 3/4" cherry (front)	P	3	1/4 x 7 1/2 x 8 3/4" hardboard (bottom)			Note: The Woodworkers' Store, 21801 Industrial Blvd., Rogers, Minn. 55376, offers a materials package containing all the cherry hardwood and major brass hardware items needed to build the toolbox as shown. Here's what each package includes:
N	2	1/2 x 1 1/2 x 7 3/4" pine (side)	Q	14	3/16 x 3/4 x 7 1/4" maple (drawer slide)			Lumber: All the cherry hardwood (surfaced three sides) required to build one toolbox, 1/4-in.-thick cherry plywood (for front panel), 1/4-in.-thick cherry plywood (for drawer bottoms), pine edging (for partition edge).
O	1	1/2 x 1/4 x 8 3/4" pine (back)	Q1	42	1/2" No. 2 fl. screws			Hardware: One locking chest latch, two chest latches, eight corner caps, ten 1/2-in.-dia. brass knobs and one pair of butterfly hinges. Total cost: \$65.
P	1	1/4 x 7 1/2 x 8 3/4" hardboard (bottom)	R	8	Brass corner caps			
		DRAWER B (1 Req'd.)	S	8	3/4 x 2 1/2" 18-gauge sheet brass (corner angle)			
M	1	1/2 x 2 1/2 x 9 3/4" cherry (front)	S1	16	3/8" No. 5 fl. screws			
N	2	1/2 x 2 1/2 x 7 3/4" pine (side)	T	10	1/2"-dia. brass knobs			
O	1	1/2 x 2 1/4 x 8 3/4" pine (back)	U	1	Brass locking catch			
			V	2	Brass catch			
			W	2	Butterfly hinge			



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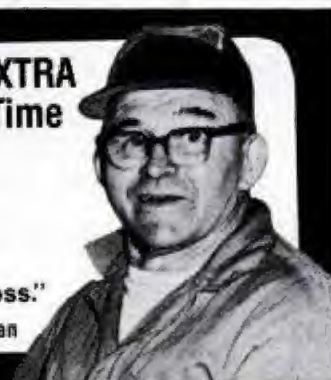
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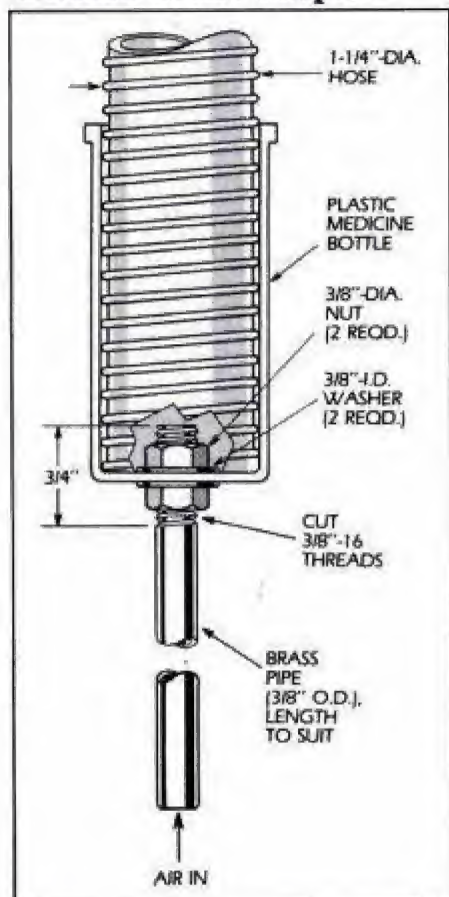


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NEW VIDEO GAMES

(Continued from page 99)

not capture the mind's eye with animation. Rather, they weave around the player a razzle-dazzle feeling of incredible detail.

The game begins as you move your tiny character on a colorful map of the world. You visit towns and villages, and as you enter them the world map is replaced by detailed maps of these

areas. Then you go through "time doors" which take you to yet other world maps in various areas of time—all while searching out an evil enchantress. Finally, you can get yourself a spaceship and take off to completely new worlds.

Meanwhile, you can chart your course on a real cloth tapestry of the Universe's time doors that's included with the game.

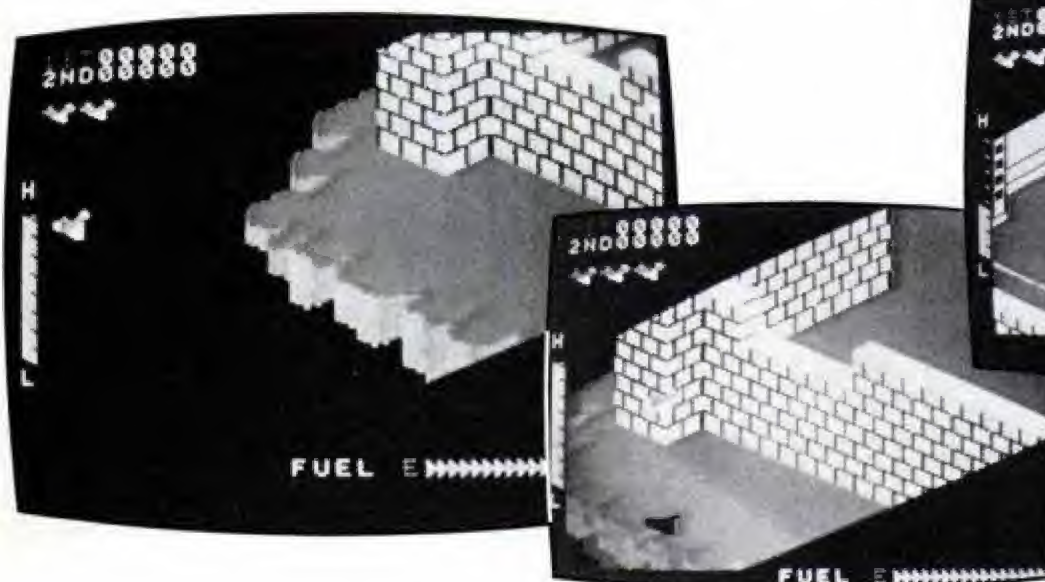
All of these games use new and rev-

olutionary techniques in video entertainment—and they are all more believable than their early counterparts. Playing them is less like playing a game on your monitor or TV set than it is experiencing a whole new world.

You're in the picture

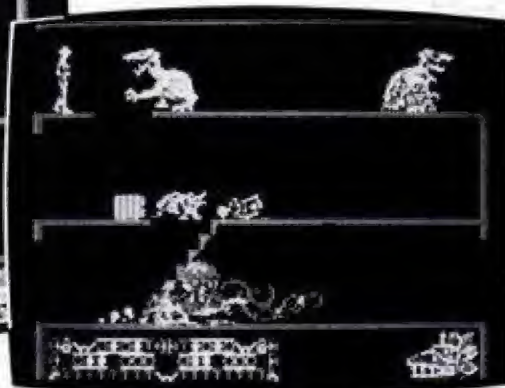
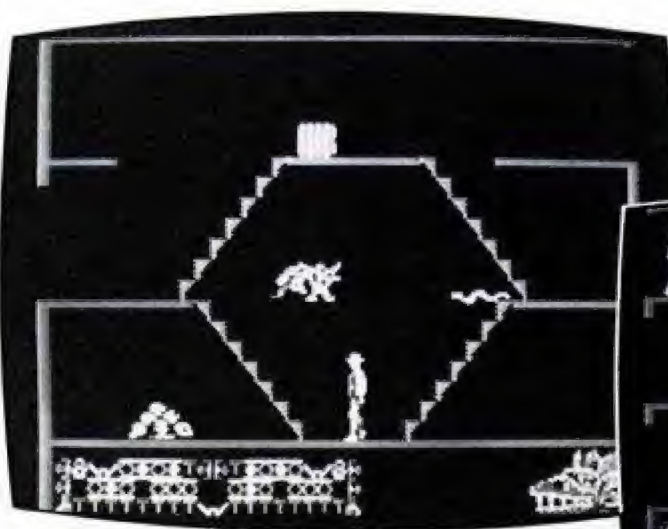
Another new style of gaming features open-ended animation where the player becomes the star of the show

(Please turn to page 186)

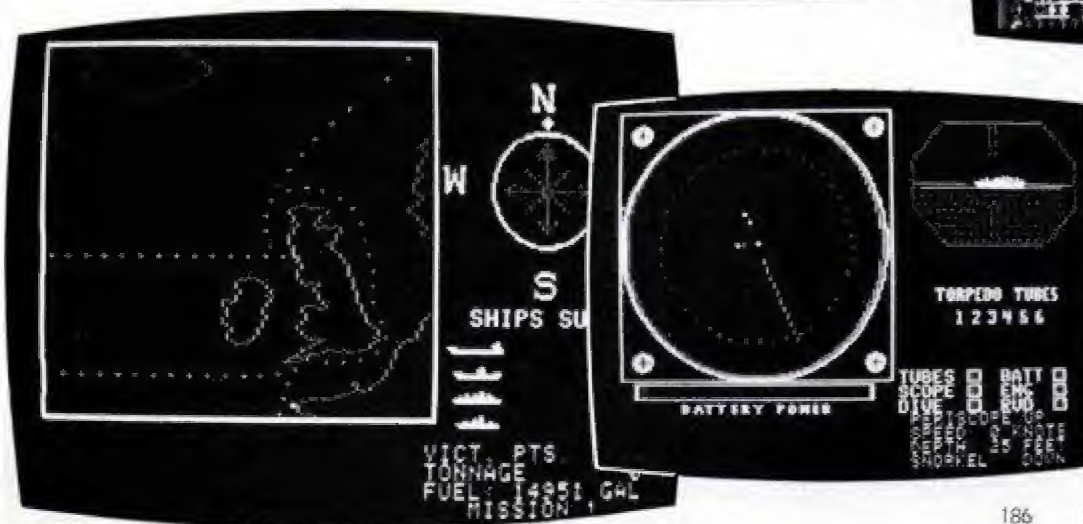


Zaxxon features a detailed, scrolling landscape of an incredibly hostile asteroid base somewhere in outer space. You must fly three-dimensionally above walls and weave about obstacles while constantly firing. A hit in the arcades, it's now a hot living-room sensation. (Colecovision.)

Aztec from Datamost is almost as much fun to watch as it is to play. You control the walking, climbing, ducking, fighting, altogether charming little man's movements as he searches room after room in an underground maze for a golden statue. From level to level he fights dangers in complete, convincing animation. A tour-de-force for the Apple II.



Fathoms 40 from Datasoft puts you in the position of shanghaied captain pressed into U-boat service. You plan your strategy on one screen (far left); then on tactical display (left) you aim your torpedoes, keeping in mind every variable of submarine warfare from battery level to snorkel depth as well as using your sonar. (Apple II, Atari 800.)





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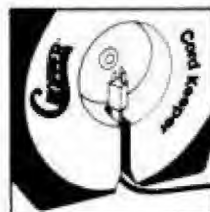


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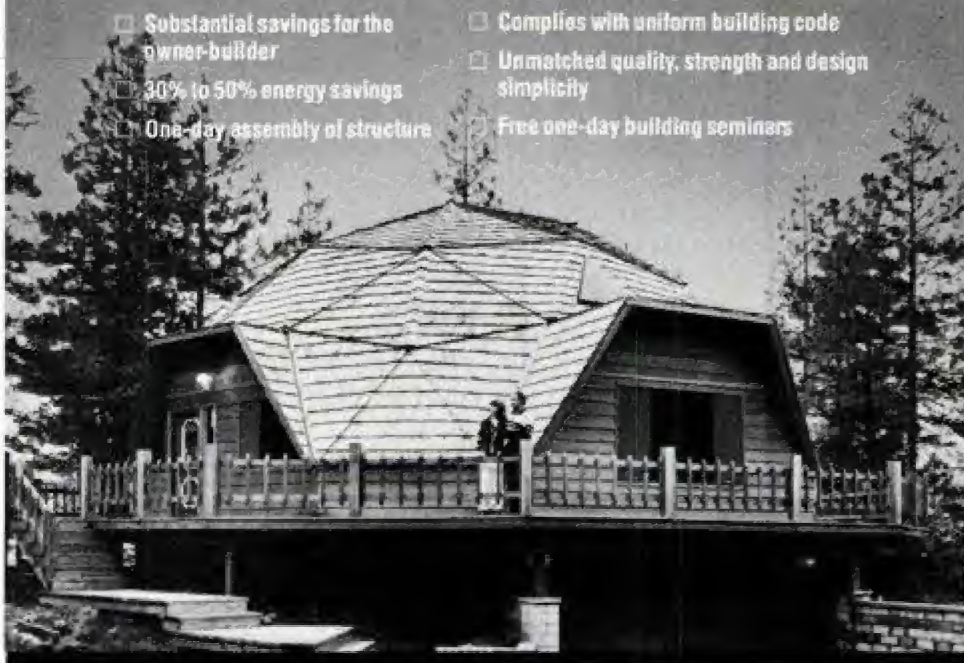


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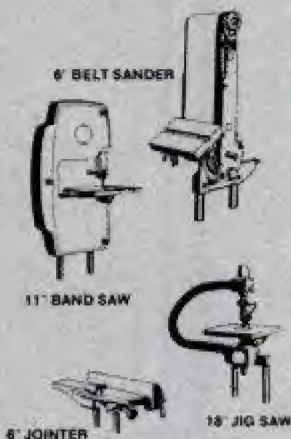
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The foregoing is excerpted from "The Book of Bugs", AquaBug's intimidating and somewhat hostile new catalog, which is free for the asking. Send for it NOW, before the lawsuits start.

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PUMPS

NEW VIDEO GAMES

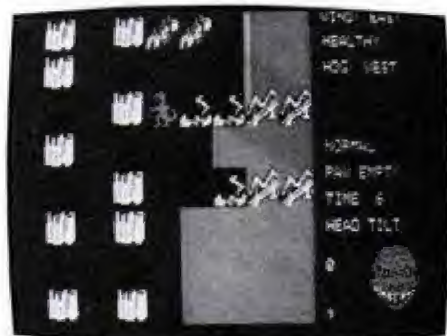
(Continued from page 186)

and controls the antics of a cartoon hero.

The game Aztec uses the theme of the intrepid explorer venturing into dank and frightening caverns seeking a golden statue.

Duck, fight and fire

During your trek through this multi-leveled maze of rooms, stairways and surprising traps the keyboard is used to control and guide the figure which quickly becomes your own alter-ego.



Crush, Crumble and Chomp through cities as monster of your choice. From Epyx for Apple II, Atari 800, IBM PC.

You can make the character duck, leap over fissures, fight with a machete, fire a pistol and generally try to avoid or do away with everything ranging from the creepiest and toothiest tyrannosaurs you've ever seen outside a Fifties horror film to pan-eared demons with sharp spears.

This type of game pictorially ensnares you into identifying with your on-screen representation. Once you get past learning to hit "J" for jump—and having to think about it first—you find that your reflexes and thought-processes easily transfer to the screen.

Choose your fantasy

The home video game has become, for many people, a way to enter an alternate and complete world of fantasy and challenge. While some would call this mere escapism, the popularity of such video travels cannot be denied. And, on closer examination, this popularity is hardly surprising.

In the dim past, a warrior could settle by the fireside and listen as the tribal bard spun alliterative chants of legendary deeds while the night beyond the fire made it all seem real.

Video fireside

Today's high-tech warriors, faces lighted by the flickering video fire, have their eyes fixed on their own legends—and for just a few moments can believe in worlds where anything may come true.

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The 1983 Plymouth Reliant K Backed for 5 years, 50,000 miles.



41 est. hwy. [29] EPA est. MPG*

AIRSHIPS RISE AGAIN

(Continued from page 95)

always fill a volume) and a bit about 'super heat.' " With the latter phenomenon, gases can expand so much that the action of the ship's rotating props and its airplane-like elevators may not assure a landing. "It can happen that as you are coming in for a landing, you suddenly 'bounce off' just as the crew attempts to take hold of the tethers," Bennett adds.

1,000 pounds of water

After a preflight check, the Skyship is "weighed off," a procedure to make sure the vessel has about 1,000 pounds of ballast in the form of water. With ballast on, the engines are started from Skyship's own batteries. They push the airship back away from its portable docking mast.

Trimmed to level with ballonnet adjustments, the airship's tether lines are loosed by its ground crew. It usually takes off at a 45° vector, but can rise vertically when necessary in close quarters.

Prior to landing, trim is checked again. Cruising speed may be maintained while the ballonets' air is adjusted until the ship flies level with its elevators in mid-position. Then a normal

aircraft descent can be made, using vectored thrust from the engines. As a ship comes to a stop, ropes are dropped and a ground crew can pull it to a permanent or portable mooring. Water ballast may be added by the crew to ground the vehicle.

Airships have many advantages over airplanes and land vehicles. Fuel efficiency is a big advantage: According to Goodyear, any of its four blimps can operate eight hours a day for nearly a week on the amount of fuel it takes a passenger jet to taxi from the ramp to the runway for takeoff. The airships also have tremendous lifting capacity and can land or take off on any space big enough to hold them—they don't need a smooth runway.

Some wrinkles remain

Still, there are some wrinkles. There are good reasons why Goodyear hasn't jumped onto the renewed airship bandwagon.

Mooring requirements make airships difficult to park for the long term. Vast hangars are necessary to keep an airship inside during rough weather. (At Goodyear's Akron facility, the hangar is so big that it has its own weather system; clouds sometimes form near the ceiling.)

A lack of free-spending airship cus-

tomers has also kept Goodyear conservative. Without a buyer, Goodyear isn't ready to build the heavy-lifter and several other experimental airships that are on its Aerospace company's drawing boards. In the words of Goodyear Aerospace spokesman Paul A. Turk:

"Except for continuing work (on Goodyear's airship fleet), we aren't engaged in airship production or research for any other customer at this time. We stand ready, of course, to build airships for qualified customers."

Getting off the ground

Airship Industries' U.S. Navy demonstration flights this year will be financed mostly by the airship company; the Navy is just providing crews for training and docking space. Still, it was the Navy that ordered the Lockheed Hi-Spot flying spyship concept. And the Navy has permitted the Forest Service to use its Lakehurst facilities for development of the big-lifter. Maybe the Navy will be the one big paying customer that the airship business needs to get it off the ground. And maybe the Greek tourist trade will lure others into using the ships for passenger service. That seems to be the kind of speculation that has kept several airship entrepreneurs floating high this year. **PM**



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SPACE SHUTTLE

(Continued from page 104)

alize the mission. In one project, we split the canister in half, with the experiments stacked on top of each other. The upper-half experiment includes a flexible air canister with tubes running to a Mylar balloon that inflates to a maximum 2 cu. ft. On a signal from the flight deck inside the ship, a solenoid switch opens the air canister's main valve and the Mylar balloon begins to inflate. A light metallic chute directs the balloon outside the canister. When it inflates, the balloon should float freely from the canister, held by thin wires and cables. Motorized pulleys and a bleeder-valve system would pull it back in.

The balloon is lined with composite solar panels which power one of three sets of batteries tucked in the very bottom of the canister. It also carries heat and light sensors connected to micro-processor recorders that are also stored in the upper chamber. The main mission is to test the effects of open space on the inflated balloon. Here, PM might give NASA a hand, since the space agency is testing balloon configurations for an unmanned probe of Jupiter.

On the second deck of the canister, we'd mount a stereo camera to take

photos of the earth from the cargo bay. Special portholes would be cut all around the canister, allowing the camera to rotate and shoot three-dimensional pictures. In addition to the solar batteries, we'd also have off-the-shelf camera and calculator batteries running our electronics.

The GAS program lets us use the astronauts twice during a three-to-seven-day mission. Two bipolar switches are connected by wire from the cargo bay to the flight deck and at two prearranged times the astronauts can flip the switches. With such a limit on the number of commands that can be given in flight, any experiment should have automatic switching wherever possible, and every switch should have at least one twin.

Other experiments suggested by PM staffers and several space experts include putting bits of plastic together with various glues in orbit. This would help determine which adhesives work best in weightless and near-vacuum conditions, an important point for space do-it-yourselfers of the future.

Astrophotographer Robert Little, a consultant to Bushnell, has suggested we fill our canister with an infrared camera. It would make an infrared map of the United States. Meanwhile, on Earth, PM would send up one or two

aircraft to take infrared photos from beneath the cloud deck. When the experiment returns, we'd run a computer analysis of the difference in heat thrown off by the Earth above and below the cloud deck. The differences would help us create a new insulation index, like an R-rating, for clouds.

NASA officials have told us that the experiment doesn't have to be absolutely original. After all, man hasn't been in space long enough to have repeated many experiments. Thus your proposal could well be a repeat of a previous gem. Most public libraries carry NASA publications on previous space experiments and on plans for future experiments. Also, check your regional office of the U.S. Government Printing Office for books on NASA programs. Two outstanding volumes are *Photography Equipment and Techniques: A Survey of NASA Developments* (GPO stock No. 330-000-453-2, \$2.60), and *The Space Shuttle* (GPO stock No. 033-000-00672-1, \$2.50). Both can be ordered from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Our competition is in two phases. Phase 1 doesn't require a lot of detailed information, and you may not need too many references to get into it. Remember, the countdown has begun. **PM**

OWNERS REPORT: CHARGER

(Continued from page 101)

a sticker price of \$10,320. Finally, I tested the new Charger 2.2 and was so impressed by how it handled, its sporty looks, and its power that I ordered one. I paid \$9,325, including tax and license, but the price made no difference. I could've afforded any of them. I just liked the Charger better."

An Illinois production manager commented, "I appreciate what Chrysler Corp. is trying to do for the American auto industry. For the most part, workmanship seems very good. The only exception is the flat-black paint atop the rear bumper. But I'm 6-4 and find the front very roomy and comfortable. The rear seat could use more legroom, and the front seats should fold flat so people can sleep inside the car."

On the topic of comfort, a Massachusetts plant employee wasn't by himself in observing. "The rear seat is a joke. I'm 5-10 and can't even sit back there without bending my head forward. Might as well call this a two-passenger car and make the hatch floor deeper and larger."

An arsenal worker from Alabama volunteered, "I like the way the Charger rides, and it really handles well in

SUMMARY OF 1982-83 DODGE CHARGER OWNERS REPORTS*

Total miles driven	2,228,983	Finish, peeling decals	8.3	Poor	0.7	Number of vehicles owned:	
Average miles per gallon:		Gearshift mechanism	7.3	Comfort opinion (rear seats):		This car only	39.9%
In town	25.2	Transmission (general)	6.9	Excellent	5.3%	Two cars	39.5
On the highway	32.5	No rear legroom	6.9	Good	17.3	Three cars	11.3
Transmission choices:				Average	35.9	Four or more cars	9.3
Automatic three-speed	21.8%	What changes would you like?		Poor	41.5	Makes of other cars owned:	
Manual four-speed	76.5	Five-speed transmission	10.6%	Had any mechanical trouble?		Dodge	24.9%
Why did you choose this car?		No changes	10.2	No	52.9%	Chevrolet	21.0
Styling	71.7%	More rear headroom	10.2	Yes	47.1	Plymouth	18.8
Economy	43.0	More rear legroom	8.2	What type of trouble?		Ford	17.1
Performance	21.5	Move heater/vent control	7.2	Transmission	21.0%	Pontiac	13.8
Price	19.2	How much did you pay?		Electrical	16.8	Age distribution of owners:	
Handling	11.6	Average	\$8,264	Fuel induction	11.2	15-29 years	60.0%
Specific likes:		Range	\$6,500-11,150	Oil leaks	9.1	30-49 years	33.0
Styling	59.1%	Workmanship opinion:		Dealer repairs satisfactory?		50-plus	7.0
Economy	53.0	Excellent	29.5%	Yes	57.7%	Would you buy another Chrysler?	
Handling	50.7	Good	52.3	No	42.3	Yes	85.4%
Performance	24.2	Average	14.3	Dealer service opinion:		No	14.6
Comfort	22.8	Poor	3.9	Excellent	20.5%	Would you buy another Charger?	
Specific dislikes:		Comfort opinion (front seats):		Good	45.6	Yes	78.6%
Rattles and noises	12.8%	Excellent	56.4%	Average	22.3	No	21.4
No complaints	12.5	Good	39.1	Poor	11.7		
		Average	3.9				

*Percentage might not equal 100% due to rounding or insufficient data.

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15-D-1

turns and sharp corners. Has great pickup out of the hole. I feel safe pulling out into traffic. It's also a popular car with the ladies."

The biggest single complaint from Charger drivers centered on rattles and general noisiness. Said a Rhode Island grocer, "Too much engine vibration and buzziness. The car needs more sound insulation." And an Alabama farmer: "Seems like you hear an awful lot of road noise inside the car. The engine backfires, too."

Nearly 53 percent of our respondents reported no mechanical difficulties. That's strictly an average score, though, and the satisfaction rate with dealer service also ranked just average.

Most Charger owners felt pleased with Chrysler's 5/50 warranty, and it definitely influenced a number of buying decisions. But a minority expressed something of a backlash.

To illustrate, a Maryland veterinarian complained, "I always feel I'm getting the bum's rush through the service department, because they know they'll have to honor my warranty a long time. I believe they don't want me to get too comfortable with it. Frankly, I don't know whether the warranty is worth all the resentment and hassle."

Not surprisingly, the Charger remains a young person's car. Sixty percent of those who answered our questionnaire were under the age of 29. Nearly 80 percent told us they'd buy another Charger next time, but several mentioned that they expected to have larger families by trading time and thus would want a bigger automobile. "Growing family requires a larger car," stated a Wisconsin accountant, who added that he would purchase another Dodge product because, "... Chrysler Corp.'s overall quality and engineering are excellent."

Most owners felt about their cars the way a South Carolina phone serviceman did when he wrote, "Workmanship and value are the best in many, many years. Charger has come alive again!"

And, finally, a highway patrolman who asked us not to mention his state, looked at his Charger in more philosophic terms: "Five or six years ago, I was convinced that Chrysler *should* be allowed to fail. That was because they were building such lousy cars at the time."

"However, I'm really impressed with the high quality of my new Charger, and I'm told that the same assembly standards also apply to other Chrysler products. I hope the trend continues, because my little Charger makes driving fun again. It brings back memories of the '60s and the great cars we used to enjoy back then."

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TECHNOLOGY UPDATE

SPACE

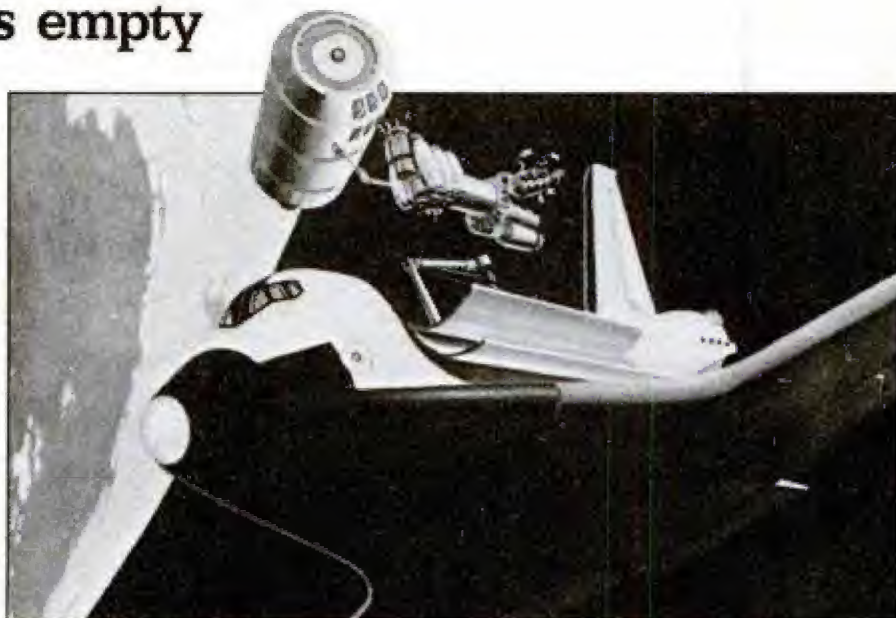
Not all of space is empty

The recent trouble with an out-of-control Soviet nuclear-powered satellite has dramatized the point that we need a way to retrieve space junk. In addition to any danger a falling space satellite or lab might pose for earthlings, the man-made debris that orbits earth presents a serious danger to the Space Shuttle or any manned craft. Some dead satellites are moving at speeds near 20,000 miles per hour, making them as dangerous as guided missiles for anything that crosses their paths.

The North American Aerospace Defense Command currently knows the whereabouts of 5,000 pieces, each a yard in diameter or larger. By the year 2000, NASA researchers say, the odds of a collision between a piece of debris and a spacecraft will be one in 200.

One solution currently under study by NASA is a "subsattellite" with its own propulsion system.

The subsattellite would be carried into orbit by the Space Shuttle. Then the vehicle would rocket to a set point, follow a piece of space debris a few minutes, then seize it with a robot arm. After



A "subsattellite" would grab space debris with its robot arm, then hand it to Shuttle.

retrieving the space junk, the vehicle would return to the Shuttle, which would pull the junk inside with its own robot arm. The retrieving vehicle would then be pulled inside, or sent on another mission to collect more space garbage.

INVENTIONS

Go soak a bridge

The air over most rivers is salty, and the salt soaks into the traffic decks of bridges causing severe damage—potholes. But Penn State researchers Philip Cady and Richard Weyers may have found a solution. They cut grooves into existing concrete decks and then fill them with liquid plastic. Then an infrared heater is run over the deck to superharden the plastic.



Infrared heater runs over bridge deck and superhardens a protective plastic in grooves cut into concrete.

The researchers say that no new salt can get in, and salt already inside the concrete is held in place. The method may extend by decades the life of a bridge deck.

No more bum steers

Take a tough cut of meat from the scrawniest steer, place it inside a new machine in Oregon State University's Meat Science Laboratory, and out comes a mess of succulent sirloins.

The device, a cylindrical steel canister filled with warm water to maintain the meat's muscular structure, applies 15,000 pounds of pressure per square inch of meat. As a hydraulic cylinder squeezes the meat to about half its carcass length, the beef grows noticeably denser and thicker.

OSU nutritionists say the meat is just as flavorful as good cuts of beef, and perhaps easier



Inside the warm, water-filled tenderizer, meat is subjected to very high pressure.

to digest than meat that has not been pressurized.

Prof. Walt Kennick developed the concept after reading about pressure-tenderizing theories in an Australian journal. He and his colleagues are still working on an explanation of why the pressurizing works.

But they're so sure it does work that they've begun building a model for commercial use.

MILITARY

Split-second bomb snuffer

A gasoline bomb tossed into an enclosed space can kill or seriously burn people. But a Hughes Aircraft subsidiary has come up with a computerized fire-suppression system that can sense and snuff out an explosion within one-tenth of a second after it starts. Santa Barbara Research Center designed its Dual-Spectrum system to meet military specifications. But New York City already has shown an interest in placing them inside the tightly closed booths from which clerks deal out subway tokens. Two booths were firebombed in the past five years.

In order to start the superfast system, two of its four infrared sensors have to register heat that comes from an exploding bomb. Two milliseconds after registering the heat, the sensors notify a computerized control box. (A millisecond is one-thousandth of a second.) Within four additional milliseconds, the computer sends a signal to the valves in two 5-pound (144-cu.-in.) cylinders filled with a



The Dual-Spectrum device smothers a firebomb in one-tenth of a second. Sensors send a signal to the control box that a fireball is emerging and it turns on retardant spray.

fire suppressor such as Halon. After about five more milliseconds the Halon is shooting at high pressure at the fire. It discharges all the fire suppressor within 50 milliseconds.

Total sensing and response time, lab officials say, is just under 100 milliseconds.

That, they say, is fast enough to prevent a token booth clerk or anyone standing near an explosion from getting seriously burned.

Similar systems already have been installed in M-1 tanks and other armored vehicles.

MARINE

Electronics gone 'in-seine'

To seine for fish you drop a large, weighted net into the ocean, marking off its boundaries with floats that bob to the surface. Spot a school of fish in the center of the net, and you quickly pull in the net—and a large catch. Such fishing has been made easier recently with the introduction of micro-chip-based systems that pinpoint a school of fish with far greater accuracy than mere sonar or human vision.

Wesmar Marine's system, shown below, lowers a sonar device from a box carried under the ship at centerline. The school shows up on a screen, and the picture is vivid and dramatic even in black and white.

The Wesmar system pinpoints the location of a school of fish and gives you its distance from the ship. The system, which was introduced early this year, is expected to be used mostly for tuna and herring fishing.



Sonar map (right) produced by Wesmar's boom (left) shows a sickle-shaped school of herring gathering near nets under a seiner.

ELECTRONICS

Testing, by Jove

When America's Galileo mission is launched later this decade, it likely will carry a soil analyzer designed for a now-scrubbed hard landing on Mars. Designed by Duwayne Anderson—dean of natural sciences at New York's State University at Buffalo—the analyzer is composed of simple "off-the-shelf" parts to keep its price down. Rows of temperature and moisture sensors would be able to evaluate surrounding terrain so accurately that the analyzer should be able to tell the difference between mere rocks and ice or snow. If Galileo is launched as planned in 1986, it would land on one of Jupiter's moons within two years. The landing would be "hard," with the capsule carrying the analyzer expected to penetrate slightly the icy ground of a moon. By digging into the surface of a Jovian moon, scientists hope to settle the question of whether any of them possibly contain life-supporting water. The Anderson analyzer would be connected to a telemetric system that broadcasts soil-water test results back at regular intervals for months at a time. Anderson is working with Bell Aerospace researchers on adding some circuitry to the analyzer to perform additional tests.



Duwayne Anderson holds analyzer going to Jupiter's moons.

AVIATION

Economy-class fighter

Rarely do defense contractors spend their own money developing weapons. But Northrop's F-20 Tigershark jet fighter has flown its 100th test mission without a single order from the defense department.

The F-20 was developed in response to a defense department call for a tactical air defense fighter good enough to sell to friendly nations around the world. No sales were promised, but Northrop has begun demonstration flights for the Jordanian and Egyptian air forces. The Mach 2-class fighter is billed as perfect for the needs of most friendly nations for the next 20 years. It has a scramble time of three minutes, meaning that within three minutes after being strapped into his seat, the pilot has his craft 17,000 feet up, 10 miles from home base with all systems combat-ready. In addition to advanced radar and communications devices, the F-20 carries heat-seeking AIM-9 missiles. The \$9



Northrop's \$9 million F-20 Tigershark has a scramble time of three minutes.

million craft—a bargain by international military standards—has flown missions at Mach 1.9 at 50,000 feet using internal fuel only in a 2-hour, 12-minute flight. Northrop bills the F-20 as an all-weather flier. Although the published figures on the Tigershark are somewhat more modest than those of the latest MiGs, the scramble time is expected to be a decisive factor in selling the jets to Middle Eastern and Asian nations. The current craft is designed as a one-seater, but plans are afoot to build a two-seater. With today's advanced avionics and electronics, jet fighter pilots stay very busy during a mission, and a second seat makes it possible to carry a gunnery officer to operate radar and missile systems in close combat.

ALTERNATIVES

Foam sweet home is completed

It doesn't sound like the best possible building material for Wisconsin's icy winters, but polystyrene foam is the stuff of which Steve and Mary Nelson's home is made. And, as if to draw a line under the word icy, the Nelsons moved into the three-bedroom ranch in McFarland on Dec. 10. Electric baseboard heating is keeping the home quite comfortable, Steve says. And Mary adds that she can look out her window at a crowded ice-skating rink across the street, but she never hears traffic through the foam walls.

The house, the first of four being built this year by Cubic Structures Inc., is made of 4x8-foot blocks of 12-inch-thick foam anchored to a foundation by reinforced steel bars. The blocks are coated on the

outside with Insul/Crete, a polymer modified Portland cement that can produce either a textured stucco or stone finish when sprayed on. The walls have an insulation rating of R-46, slightly snuggier than required by local building codes.

Foam house designer Don Peterson says the homes are selling for \$68,000 to \$80,000, which he calls competitive with traditional homes. Peterson has gone to great lengths to show how tough an insulating foam can be. He drove a 7¼-ton truck onto the Nelson's foam roof before it was installed to show that the blocks can take tremendous amounts of weight.

Although the first heating bill hadn't arrived by press time, the Nelsons told us they expect to spend much less on heat this season than they did last year.

Steve was surprised at the speed with which the foam walls went up. "They actually put the outside walls up in a single day," he notes.

Some small-scale foam houses have been built at Department of Energy research centers around the nation. But no one



The walls are 12-in.-thick foam blocks coated on the outside with Insul/Crete.



The polystyrene roof was tested with a load of 7 tons before it was installed.



The Nelsons pose outside their home of polystyrene foam.

lives in any of those structures. The DOE foam buildings were outfitted with sensors and are still undergoing evaluations for insulating and other properties. Meanwhile, Cubic Structures is building two more foam houses in Minnesota and another model in Houston. They will go up for sale later this year.

Editor: Dennis Eskow
Contributors: Mort Schultz, Yvonne Michie Horn

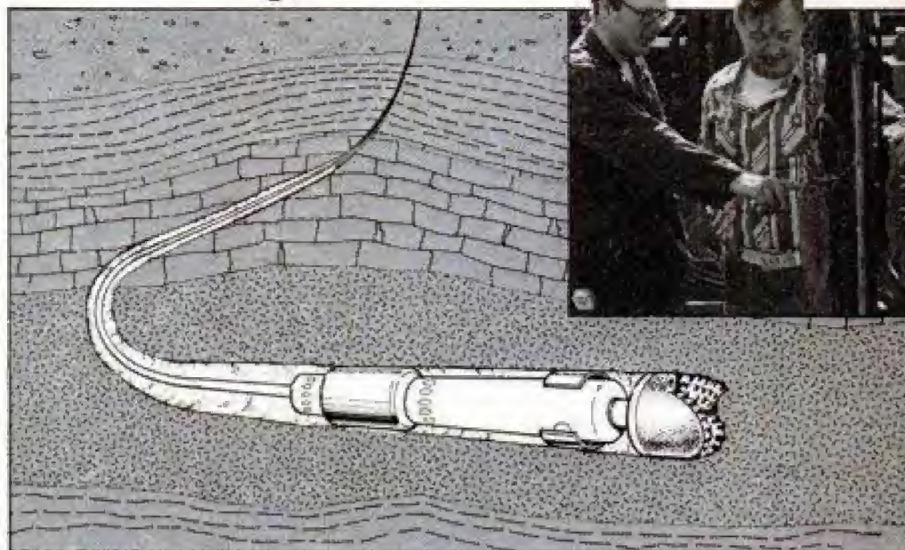
ENGINEERING

The drill you steer

There's got to be something better than brute force," says Harold Nissley, chairman of California's Advanced Drilling Co. Nissley's company will find out this summer whether there is something better when it comes to drilling for oil. They'll be using the firm's new steerable drill that, instead of pounding through layers of rock, can be steered from ground-level to avoid hard pockets of rock as it seeks out oil or water deposits. Called the Robot Drill, the system uses a hydraulic inflatable cuff to angle off as it digs into the earth.

Invented by two Stanford University researchers—Robert Horstmeyer and Larry Weick—the drill's cuff, located behind the drill head, can be inflated to grip the sides of the drill hole. The cuff's four compartments can be inflated separately, pushing against just one side of the drill hole and steering the drill head. Nissley says a more advanced model of the Robot Drill will have, in addition to the cuff, a set of hydraulic jacks radiating out from the area just above the cuff. The jacks will provide extra accuracy in steering the snake-like drill.

Horstmeyer conceived the drill while at



Harold Nissley (inset, left) examines the Robot Drill's steering shaft with Robert Horstmeyer. The drawing shows the shaft snaking under a layer of thick rock.

the U.S. Naval Academy. He says he was impressed by the ways the Navy uses hydraulics in nuclear submarines.

In a standard drill rig, a drill head is stuck at the end of a 93-foot-long pipe. Weight is added to the pipe to force it down. By holding onto the side of the drill

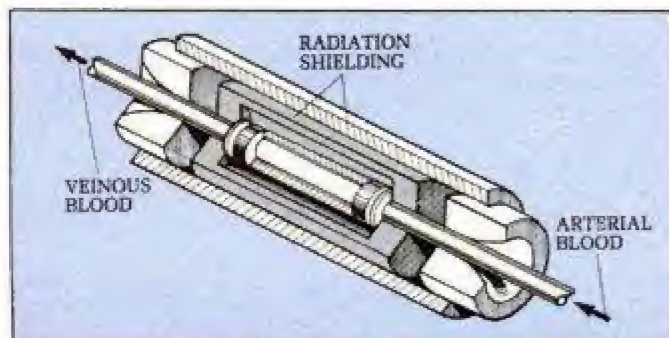
hole, the Robot Drill can offset the torsional and forward thrust of the head.

The drill stem is 10 to 20 feet long. With the steerable drill, Nissley says, the drill head can be pulled out of the ground about 10 times faster than with standard systems, making replacement cheaper.

MEDICAL

Cleaning blood for transplants

Organ transplant patients are in greatest danger just after surgery. That's when their blood contains high levels of white blood cells which can trigger organ rejection. But Battelle Memorial Institute researchers have developed a portable blood irradiator that can kill off enough white blood cells to prevent organ rejection without seriously damaging other body cells. The device, so far tested only in animals, fits in the palm of your hand and can be hooked up to blood vessels at any part of the body. One end of the tubular structure is attached to an artery, which pumps blood into the irradiator and out the other end into a vein. Inside the irradiator, a small amount of thulium 170 puts out 2,000 to 5,000 rads per day of radiation. That's a very small



dosage. But researchers at the institute say the level lowered the white cell count in experimental animals by up to 25 percent within five days.

Breast cancer war

Medicine needs every weapon it can get in the war against breast cancer. And now a new breast cancer detection system that uses no X-rays has been introduced into the arsenal. It is not meant to take the place of mammography, the low-dose X-ray system that detects breast cancer early. But the new system lets doctors examine a patient's breasts more frequently than before without subjecting her to increased dosages of X-rays. The new device, Thermascan, is a wrap-around Mylar belt containing encapsulated liquid crystals whose colors change when exposed to heat. By taking several readings over an extended period, the doctor can see changes in the breast's temperature profile, indicating very early growth of a tumor. The Thermascan company says the product will soon be available by prescription for women to use at home.



Thermascan senses breast heat to find tumor growth.

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A Complete Phone Answering System
If you press the "Prefix" key, the "Clear" key, the Direct Memory Keys, or any of the other special function keys (more about these later), your Phone Voice tells you what you've pushed. If you get tired of company, you can shut off the voice; but it's like having a friend right inside your phone.

This feature takes some explaining.
In the bank of keys to the right of the dial pad are three marked M1, M2, and M3. M1 and M2 will tell a caller, when you're out, either when to call back or another number where you can be reached.

What about M3?
M3 makes any cassette recorder an answering device. Using the connector (supplied), your recorder can take messages up to the total length of any tape cassette. The Everything Phone turns the recorder on and off automatically when a call comes in.

So—you have your voice of 1) a message, in the phone's own voice, to call back at whatever hour you designate; 2) a message that you're out and can be reached at whatever number you designate; 3) an invitation to leave a message after the tone, with a capacity as long as the cassette—an hour or more.

Memory Keys Galore for Automatic Dialing

At the left of the numeric keypad are ten Direct Memory Keys. The key at the upper left is for MCI, Sprint, or other computer-code dialings. It holds the access number and your personal code number.

The other nine let you dial stored numbers, including long distance numbers, by pressing one key. You can inset a tab showing whose number is stored.

But you ain't see nothin' yet!
You actually can store up to 50 numbers of 20 digits each, using a two-number code. Example: if you already have 30 numbers in memory and you want to store 1-305-473-2044, punch in that number, use the "Store" key and "31", and you'll be able to dial that number in the future just by pressing "31".

Quality Speaker-Phone

Of Course The Everything Phone has one-way speaker-phone capability. Of course it's high quality sound.

Just press the "Speaker" button and you have a hands-free phone. A volume control gives you just the right amount of amplification.

Music on Hold; "Mute" Switch

You can put a caller on hold just by pressing the "Hold" key. What a pleasant surprise! Instead of dead sound, the person on hold hears a pleasant melody. (You'll hear it too, so you won't forget he's on hold.)

You have a "Mute" privacy button, and it couldn't be more convenient—it's right in the center of the modern hand-phone. Press that button, and although the other party won't be able to hear you, you'll still be able to hear him or her. Release the button and communications are normal again. (No tell-tale "click" when you press the Mute button.)

Here's a List of Other Built-in Benefits

Your Everything Phone is an electronic butler. It has—
— Automatic redial. Press this key and your phone will redial the last number you called either once (if the phone is off the cradle) or four times (if the phone is in the cradle).

Each key has a separate function. Each one talks to you, if you want it to. What a conversation piece The Everything Phone is!

- Pulse/Tone selector switch. In areas with rotary dialing only, slide the switch to "P". In areas with touch-tone, slide it to "T".
- Ringer off switch. You can turn off the pleasant "chirper" (it isn't a bell) when you don't want to be disturbed. A separate ringer i.e.d. light will alert you, if you're interested.
- Access pause key. For Sprint, MCI, and other code numbers, the Pause button gives you the proper gap between the original dialing and the time the system takes to answer with a tone. The Pause has other uses, too, but we just can't list all of them here.
- Secretarial aids. Open a little door and you have a memo pad to jot notes. For the numbers stored in automatic dialing memory, slide out the Directory Card, concealed under the phone unit.
- Battery backup. Two tiny, easily replaceable batteries keep your memory intact. A power failure, even one that lasts for months, won't wipe out what's stored in the memory.

Anything Else?

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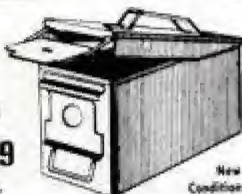
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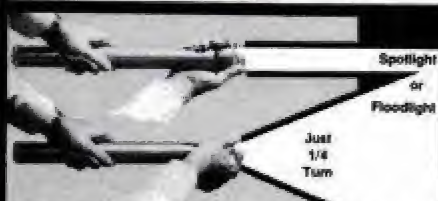
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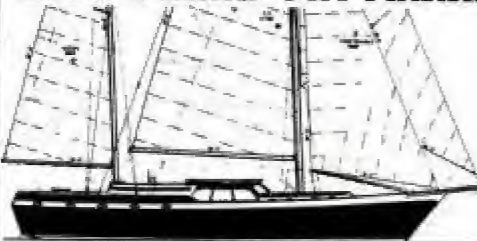
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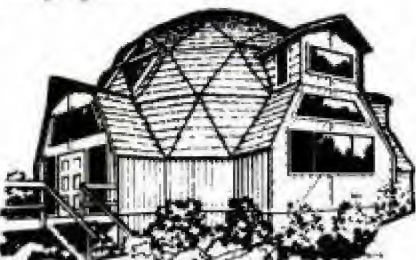
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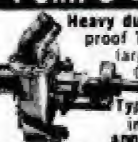
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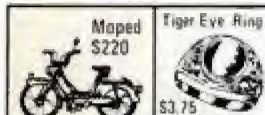
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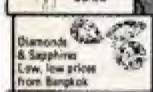
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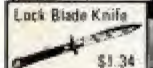
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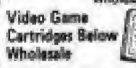
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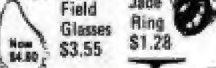
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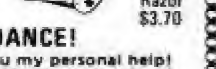
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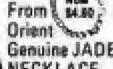
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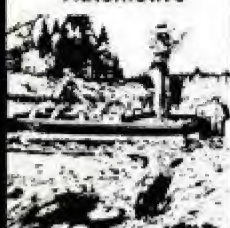
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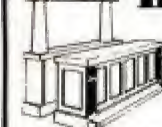
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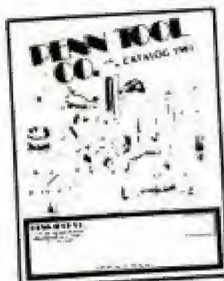
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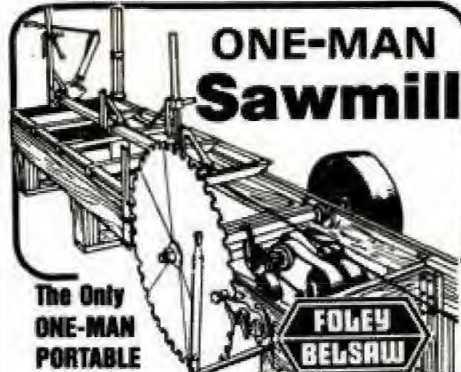


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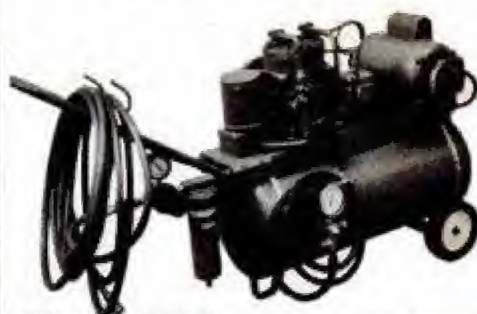
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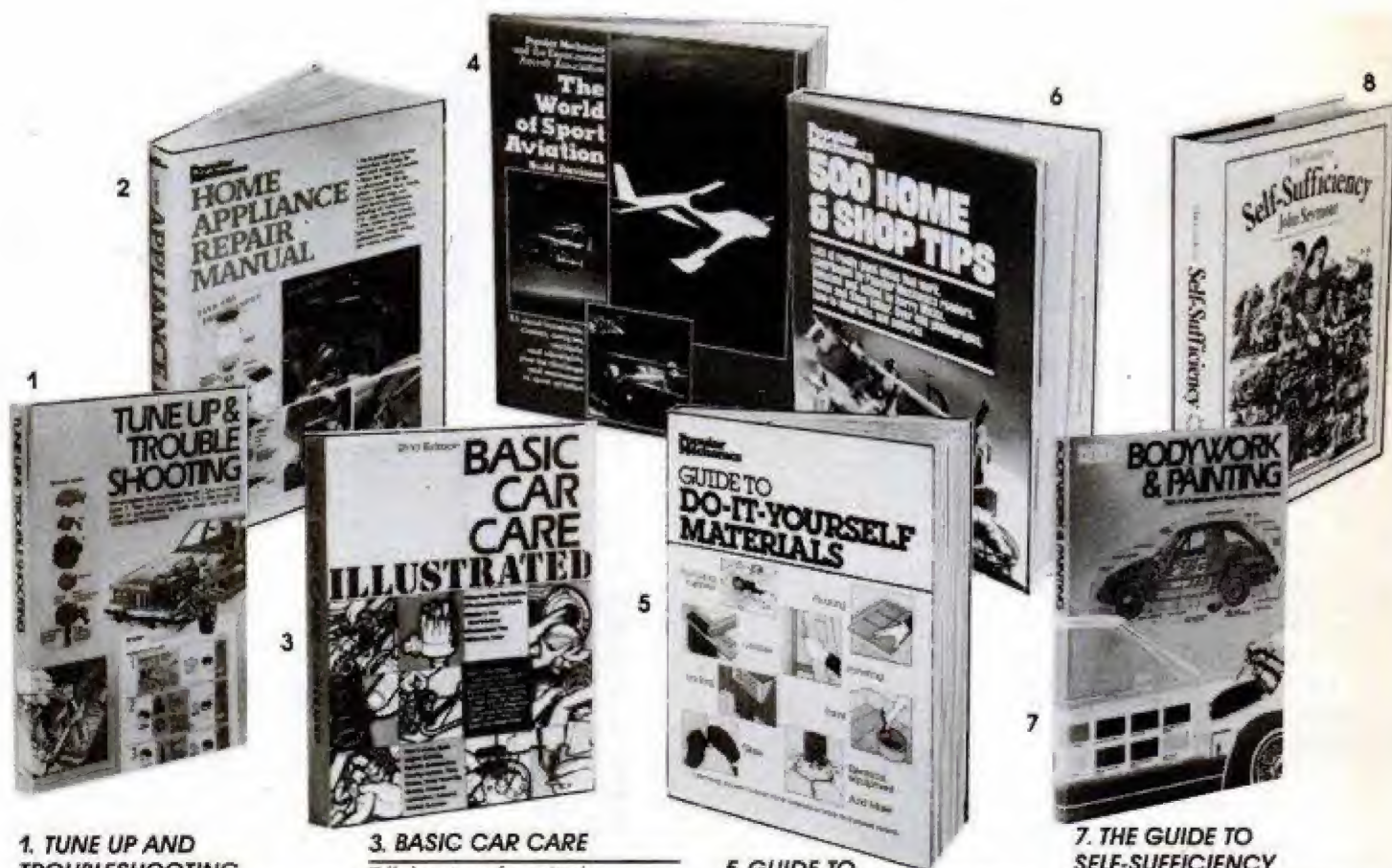
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RED L.E.D. LIGHT FOR CALLS RECEIVED. Light will flash if messages have come in while you were away.

FULL-FEATURED KEYBOARD Simple and convenient, the Cobra Remote is the only all-push-button machine with all the luxury features including fast forward, fast rewind, and remote rewind.

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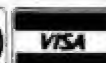
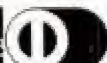
Charge my: ☐ VISA ☐ MC ☐ DC ☐ AM EX ☐ Phone # _____

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Estimated Highway MPG. (26) EPA Estimated MPG.**** Add that to the electronic ignition system, 4-speed synchromesh transmission and power-assisted brakes, and you've got the goods to make the delivery easy. Normal maintenance an infrequent and simple affair. And durability something you can bank on.

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* Manufacturer's suggested retail price. Dealer's actual retail price may vary. Price does not include tax, license, transportation, optional or regionally required equipment.

** Including occupants, equipment and cargo.

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**** Remember: Compare this estimate to the EPA "Estimated MPG" of other gasoline-powered trucks with manual transmission. You may get different mileage depending on how fast you drive, weather conditions and trip length. Actual highway mileage will probably be less than the "Highway Estimate".

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